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ELECTRICAL REVIEW.

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LEEDS AND THE ELECTRIC LIGHT.

IN May, 1883, the Council of the Leeds Corporation voted the sum of £10,000 "to carry out an experimental system of electric lighting within and about such portion of the Municipal Buildings as may be considered desirable." An Electric Lighting Committee was appointed at the same time to carry out the wishes of the Council. Now, a period of six years having elapsed, the members of the Electric Lighting Committee have issued to the members of the Town Council a report, consisting of 27 pages demy octavo, explaining at some length how the money has been expended, and with what success. The total expenses incurred up to the present has been £10,233 18s. 11d., or practically the amount originally voted. For this large amount of expenditure all that the committee have to show is the lighting of the public library by incandescent lights, and the arc lighting of the Victoria Hall, the former of which was not completed until some expenditure was occasioned by threatened litigation. The remainder of the above large sum has been disbursed in the numerous expeditions of the various members of the committee to innumerable places in the United Kingdom during the past six years to investigate the various possible and impossible systems of electric lighting. The result of their first inspections and report ended fairly well in a *fiasco*, but we have now the final conclusions which the committee have arrived at, and the recommendations which they place before the Council—it is but right to point out that this report is not submitted until *all* the money voted has been spent.

The committee recommends that the arc lights, rendered unnecessary by adapting the electroliers to the present installation, be removed from the Victoria Hall and placed in the streets surrounding the Town Hall, and the offices in the Municipal Buildings. Also that incandescent lighting be introduced into the Council Chamber, the four courts, and the corridors and offices of the Town Hall, and the offices in the Municipal Buildings. These works will cost £3,000. Whilst the Council's instructions to the Committee were limited to the making of experiments at and about the Town Hall, the Committee had deemed it to be its duty to go generally into the question of lighting by electricity the centre of the borough. The Committee find that the desire of the tradespeople to have the electric light is almost unanimous. The Committee then mapped out a district bounded by Vicar Lane, New Market Street, Duncan Street, Briggate down to the bridge, Boar Lane to the New Station, Park Row, Guildford Street, Upperhead Row, New Briggate, and North Street to Vicar Lane. The number of public and private lamps required for lighting this area was estimated at 37,000. The following extract concludes the report :—

> In regard to street lighting, your Committee reports that whilst incandescent lamps have proved a complete failure, should the Council at any time think fit to light the streets of this district with arc lamps, the system here dealt with readily permits of the same, as the power required is only equal to 4,000 incandescent lamps, which number is included in the total, 37,500. From this fact, too, the Council will understand that this system permits customers to use either arc lights or incandescent lamps, or a combination of both. The lamps in this scheme are taken nominally at 10 candle-power, but they will no doubt be burned somewhat higher than that. Your Committee has obtained tenders from several of the most successful electric lighting companies for carrying out the lighting of the district previously described. Averaging these tenders, and adding the value of land and other necessaries not included in the tenders, together with 5 per cent. for contingencies, the total cost amounts to the sum of £58,000. Whilst there can be no doubt as to the suitability of the district chosen, your Committee would point out that from the nature of the business of that district, a large demand for the light will not extend far into the evening, and that, consequently, the initial or extra cost of getting up steam and maintaining it during the hours of small demand will make the cost of production more than if, in addition to the district chosen, there could be added a considerable number of private residences which would take up the demand as places of business and shops ceased. This feature could be added to the scheme already described by laying down mains to residential portions of the borough. This would cost an additional £10,000, making, with the £58,000 required for the central town scheme, £68,000. Whilst the latter amount would be required to carry out the whole of the scheme described, it must be remembered that, as is seen from the description of the places visited, an electric lighting station consists of a unit or initial plant, multiplied from time to time as the demand for the light increases. For this reason your Committee would not advise the central

lighting installation for Leeds to be, in the first place, larger than would involve an expenditure of £25,000. Comparing this with the present price of gas in Leeds, electric lighting can be supplied at 20 per cent. above that price; but as the customers would have in addition to pay for renewing their lamps, this would probably add 40 per cent. to the total cost, according to the present price, or taking gas and meters at 2s. per 1,000 feet, the electric light would be equal to the price of gas at 3s. 5d. per 1,000 feet. It is left to others to calculate the indirect but great advantages of electric lighting when compared with gas lighting, as affecting health, goods, furniture, books, decorations, &c., and the absolute freedom of the electric light from explosions and personal injury. To sum up, your Committee concludes as follows:—1st. That it is desirable to keep the control in its own hands of what may prove eventually a very important business, deeply affecting the duties and responsibilities of the Council. 2nd. That the Committee can undertake electric lighting at a cost to the consumers of, say, one-eighth of a 1d. per lamp per hour, whilst a company could only do so at a cost to the customer of double that price, *i.e.*, one-fourth of a penny per lamp per hour. 3rd. That should a company undertake the lighting, any saving in the cost of production would not at once benefit the consumers, as it would only be given at the termination of periods of rest of probably seven years. 4th. That as a company, under the Act of Parliament, would have powers lasting 42 years, it is not desirable to give such company possession of the streets of the borough for so long a term, and with statutory powers which would interfere with any other new service requiring the use of the streets. The Council has already had experience of this in regard to the tramway company and the late gas company. 5th. That, although it is competent for the Council under the Act of Parliament to agree with a company for a shorter term than 42 years, this can only be done by granting compensating advantages to the company. Finally, the Committee resolved:—1st. That the report now read be adopted, and a copy forwarded to each member of the Council. 2nd. That the Council be recommended to light by electricity such portions of the Town Hall and Municipal Buildings as are described in the report, at an estimated expenditure of £3,000. 3rd. That the Council apply to the Board of Trade for a Provisional Order under the authority of the "Electric Lighting Acts, 1882 and 1888," authorising the Corporation, as the local authority under the Acts, to provide and supply electricity for public and private lighting purposes within the area referred to in the report, at an estimated total capital expenditure of £68,000, and that the Town Clerk (in conjunction with the Electric Lighting Committee) be authorised and empowered to take all necessary legal and other proceedings, and to give all notices on behalf of the Council which may be necessary in connection with the application to the Board for and obtaining such Provisional Order. 4th. That the Council authorise the Electric Lighting Committee to carry out and complete an initial installation of electric lighting within the district mentioned in the report, at an estimated capital expenditure of £25,000, such sum being part of the sum of £68,000, to be borrowed under the authority of the Provisional Order. 5th. That the Chairman be requested to give notice of the necessary resolutions to be moved at the next meeting of the Council for carrying the foregoing recommendations of the Committee into effect.

It is to be hoped that the Council at their ensuing meeting in July will take some active steps to carry out the tardy recommendations of their committee, and that shortly Leeds will be able to show a good example in the matter of electric lighting. Their circumstances are somewhat different to that of most towns, for the inhabitants in Leeds are indebted to private enterprise for their illumination, and not to the Corporation, who, in this case, will not have the question of being their own rivals in the matter of light.

It would certainly be worth the consideration of the Council to obtain some more satisfactory explanations as to the great delay in the issuing of a report and a recommendation from the committee, and why the investigations and report were delayed until all the money voted had been spent, thus leaving one with the very unsatisfactory inference that had there been more money, there would have been more investigations, and consequently more delay.

FROM an electrical point of view the Workmen's and Apprentices Industrial Exhibition, which was opened at the People's Palace, Mile End, E., on the 8th inst., and which will close on the 6th July, contains but little of interest. By the courtesy of the Postmaster-General there is shown a single current duplex Morse sounder and recorder circuit, a single needle and double plate sounder circuit, a Wheatstone A.B.C. circuit and a Gower-Bell telephone circuit. These apparatus have all been fitted up for actual working. The next exhibits in importance shown are those displayed by the Regent Street Polytechnic Institute, and which have been made by the students attending that institution. A four-light standard electrolier is exhibited by Ralph Davis and an ingeniously constructed Wimshurst influence machine by E. D. New; a 30 candle-power dynamo by C. Caswell; a miniature telescopic electric standard lamp by R. Haxton. A combined electric call-bell and burglar alarm is exhibited by J. R. Tozeland and a small glow lamp of about 2 C.P. by W. Balch. A battery is attached to the latter, so that by pressing a push button the circuit is completed and the lamp lighted. A model of a shunt wound dynamo is shown by F. W. Crocker, one of the People's Palace students. There are also exhibited various small dynamos, induction coils, batteries. Mechanical engineering is much better represented than the electrical trade, there being a good many beautiful models of different kinds of steam engines, &c.

THE prospectus has been issued of the Scottish Electric Supply Company, who propose to establish in Edinburgh and the surrounding district an electric supply for almost all purposes. It has secured ground as a central station at Lochrin, near the Union Canal, where there is ample room for extension, and where coal can be had at a cheap rate. It is pointed out in the prospectus that the superiority of electric lighting over all other illuminants is generally admitted, while as a motive power electricity is now being utilised in a multiplicity of ways. Under the recent Electric Lighting Act the position of supply companies has been greatly improved, with the result that capital is now being largely vested in such companies in London and other towns in England. It is intended to exercise due caution in introducing the light. They do not intend at the outset to raise a large capital, and will only make further issues when money can be profitably employed. The capital of the company is £100,000, in 10,000 £10 shares, but the present issue is limited to 2,500. Holders of the present issue will have a preference in application for future issues. The lists opened on Monday last and will close on Saturday.

THE *Temps* of Paris draws attention to three fires which have lately taken place in the Exhibition, the origin being due to insufficient insulation in the conducting wires. The first two were easily overcome by the means for fire extinction placed at the disposal of the Exhibition *employés*. The third, however, threatened to be a serious one, and was only extinguished after half an hour's work. When one considers, says our contemporary, the number of cases of accidents due to scamping work, it seems regrettable that consumers do not engage some responsible and honest consulting engineers to advise them on the subject, instead of going themselves direct to contractors, who too often follow their own immediate interest, and deliver scamped work. The trade should protest against such things as being both injurious to the industry itself, as well as to the reputation of those engaged in electric lighting enterprise.

IT having been observed that few persons frequent the Parisian Boulevards during wet weather, and that consequently the electric light therein installed is *de trop*, our restless, ingenious neighbours have discovered that an automatic cut-out can be easily fitted to their installation by laying naked copper wires in a cement trough under the pavements. The merest child in electrical matters will not fail to see how successful such a system must be. The system has not, however, been absolutely successful, the designers having neglected the function of percolation. It therefore happens that it is only after, and not during the rains, that the automatic action is absolutely a success. As the variable insulation material has given such excellent results, it is rumoured that there is some syndicate at work on an extra patented process for doing away with conducting wire, which has the great disadvantage, even under the best conditions, of offering a resistance to the passage of the current, and causes an enormous loss of energy. Although not absolutely an infringement in the eyes of the law, the operations of this syndicate have been greatly impeded by another, who have a patent with numerous claims, which does away with all the difficulties heretofore experienced; but this is too radical to be successful, we hope, as it amounts to doing away with the electric light altogether.

A PROPOSAL is on foot to construct an electric telpherage railway between Brechin and Edgell. At a meeting of gentlemen interested in the matter held at Brechin on Friday last, it was explained that the railway would be about six miles long, and, roughly speaking, the cost would be about £16,000. The speed would be about 12 miles an hour for a train of five carriages. In the course of conversation it was contended that the carrying power of the railway would be inadequate for the passenger traffic in the summer time, while in the winter time the amount of traffic would be insufficient to pay. It was ultimately agreed that these matters would be considered along with the engineer's report. We may add that the carriage of goods between the two places is at present from 4s. to 4s. 6d. per ton, whereas by the telpherage system it is estimated that it would not be more than 8d.

THE electrically-lighted train to which we referred in a leading article on June 14th is still running very well, and with a good light. On the 29th it will have had a month's work—400 miles a day—six days a week. Mr. Langdon then proposes taking the secondary batteries in the dynamo van to pieces to see how they have stood the test, as they will have experienced the fullest force of the charging. If buckling has taken place, we fear it will not augur well for the future, but it is to be hoped that such will not be the case. Even if the worst happens, however, there are other types of battery in the market which would give satisfaction on this very important point. The charging has been very regular—much more than was anticipated would be the case, considering the number of parallels. This, no doubt, is due to the slight resistance which Mr. Langdon inserts in the battery connection, but which, of course, does not appear in the lighting circuit. The "series" train will probably run next week, as the 10 a.m. out of London, returning from Liverpool and Manchester the same evening. The series system will no doubt be better for the batteries, but it carries more objections than does the parallel, the chief of which is the possibility of short-circuiting the batteries.

THE fatal accident to a workman in the employ of Messrs. Siemens Bros. from an electric shock is likely to again cause the public mind to become agitated with regard to the dangers to be apprehended from the employment of high tension currents. There is in this case, the particulars of which we publish elsewhere, no direct evidence to show whether the shock was delivered by a continuous or alternating current machine; but we imagine, from the testing instrument employed, that the dynamo was of the first mentioned type. The circumstance, in any case, is very regrettable, but there is one consolation to be gained from the incident, and that is, that all tenders of electric lighting plant will, at all events until the remembrance of the event has passed away, be extra careful in manipulating the apparatus which is placed in their charge.

OUR contemporary, the *Engineer*, gives in its last issue a description of Mr. Langdon Davies's "phonopore." Illustrated descriptions are also given of the Van Rysselberghe system and of the Edison phonoplex. It is pointed out that the latter bears a strong family likeness to Mr. Langdon Davies's invention. If we are not much mistaken the likeness is much closer than that indicated, as the illustration of the Edison system is only one of the methods of carrying out the latter gentleman's ideas; the vibratory relay receiver was, we believe, distinctly employed by Edison in his phonoplex. In what way an induction coil with one end of each coil disconnected differs from a condenser it is difficult to see. The one point of novelty in the phonopore appears to be the use of a triple wire induction coil, two wires of which are used condenser fashion, whilst the third is used as a closed primary circuit for transmitting, by means of a vibrating reed, a series of impulses; this idea is decidedly ingenious. The Van Rysselberghe system, we believe, is but a very qualified success, and we doubt if Mr. Langdon Davies will have better luck, for the elements which cause the former to fail are not got rid of by the latter.

THE result of the Edinburgh compound winding suit, which we publish on another page is, we believe, in perfect accord with the opinions of all unbiassed individuals who closely followed the evidence and who had the history of the dynamo-electric machine at their fingers ends. We congratulate Mr. Varley on the learned Judge's decision. The life-long labours of this scientific man have never received that recognition which is so justly their due, and we feel that the majority of those who earn their livelihood in the manufacture of dynamos are scarcely conscious of the vast debt which the electrical industry owes to him. When Lord Trayner's full judgment is placed before our readers it may be that Mr. Varley's discovery of the reaction principle and his application of compound winding to the field magnets of dynamos will be more forcibly brought to light, and it would not be out of place if the acknowledgment of his services to the trade took a practical form.

ELECTRIC LIGHTING AT MARIENBAD.

[A COMMUNICATION.]

THE celebrated Bohemian watering place, Marienbad, has been lighted by electricity since May 30th by means of an installation which the town, as proprietors of the baths, have installed at their own expense, and are working on municipal account. The electric plant was originally planned for a consumption of light of 35 arc lamps at 12 ampères, 14 glow lamps at 15, and 40 at 32 normal candles for public lighting, and 1,200 glow lamps for private use, and an order on this scale was given to the firm Ganz & Co., of Budapest. But even whilst this arrangement was being carried out, the demand for the light on the part of private householders had increased in so unexpected a proportion, that instead of three machines and boilers four became necessary. This supplementary order was carried out accordingly.

We give below a brief description of the enlarged installation.

The building for the engines and the electrical apparatus is in the grounds of the railway station at a distance of about 2,000 metres from Marienbad, and consists of a plain, roughly-built, one-story building of the superfices of 600 square metres. Sheds for coal and slack are outside. The building consists of two parts, separated by a wall, and serving respectively for the machinery and for the boilers. The current is produced by four dynamos, driven directly by the engines. The machines are alternators, of Zipernowsky's system, excited from without, and have a capability of 50,000 watts each, a speed of rotation of 500 revolutions per minute, and require each a driving force of 80 effective horse-power. One machine is kept in readiness as a reserve. For driving the dynamos Westinghouse engines are employed, built by the firm Alley and Maclellan, of Glasgow, which are directly connected with the dynamos by means of flexible couplings. The engines have a speed of 500 revolutions per minute, and yield each 80 horse-power. For magnetising the light machines special continuous current dynamos are employed. Of these machines there are three, one of which is kept in reserve. They are driven from the steam engines by means of belting, and have each a capability of 3,000 watts. Their belts can be regulated by means of a special arrangement. All the steam engines, the light, and the exciting machines are placed on separate foundations of concrete. Strong screw bolts with cast-iron plates connect directly the foundation blocks with the machines to which they belong. To produce the necessary motive power there are used four boilers by the firm Ringhoffer, of Smichow, near Prague. They have a working pressure of 7 atmospheres, with complete safety fittings, and arranged to burn lignite. The boilers are fed with water by means of steam-pumps and injectors. There are two steam-pumps, each raising 9,000 litres water hourly. By one pump the water is drawn from a well in the boiler-house into the reservoir, whilst the other feeds the boilers. The two pumps can change their duties. As a reserve there are also three injectors, one attached to each boiler. As a reserve tank there is used an iron reservoir, fixed upon traverses at the height of 2½ metres above the floor, and holding about 6 cubic metres, fitted with a water-guage and over-flow pipe. For greater economy there is provided a feed-water warmer, heated by means of the exhaust steam, so that the water driven in reaches a temperature of about 70° C. The steam-pipes leading to and from the engines to the pumps and the injectors are either cast-iron pressure tubes or patent welded wrought-iron tubes. The knee and compensation pieces are partly of cast metal and partly of copper. The separate feeding water, sucking and pressure pipes, as well as all the other pipes, are made of extra strong wrought-iron tubing. There are also automatic conductors for condensed water and for its separation. The hot pipes are protected against loss from the radiation of heat by a coating of the best non-conductive mass. The electrical primary and secondary leads are carried upon pillars at the distance of 30 metres apart. Outside the town these are common telegraph supports; in the town they are ornamented and arranged so as to be painted with oil. The transformers for the public lighting rest on ornamental pillars with cast-iron feet and casings of sheet-iron with a cast-iron plate and cover; those for private use in houses, in dry localities, capable of being locked up, are partly also placed on wooden supports. The transformers are mounted on iron plates, and their clamps are fitted with safety contacts on porcelain feet. Both the arc lamps and the glow lamps are inserted parallel, and therefore any single one can be inserted or removed at pleasure. As regards the regulation of the current it has been arranged that this can be effected at the central station, and for the most part automatically. Lightning plates are introduced at different places to protect the leads and apparatus against atmospheric electric discharges.

After midnight 60 glow lamps are used for lighting the streets in place of arc lamps. In winter only glow lamps are used.

The private lighting includes at present 1,800 glow lamps and 48 arc lamps, used by 59 subscribers.

NEW FORM OF GAS BATTERY.

MR. LUDWIG MOND and Dr. Carl Langer have invented an improved arrangement of the well-known gas battery invented by Grove 50 years ago, which

Alternating Current Machine "A."	No. 1.	No. 2.	No. 3.		No. 5.		No. 6.		No. 7.	No. 8.
Maximum performance in watts	10,000	20,000	30,000		50,000		80,000		160,000	380,000
„ tension at terminals in volts	1,000	2,000	2,000		3,000		5,000		5,000	5,000
Rotations per minute	830	830	625		500		360		170	125
Total weight in kilos.	...	...	1,700		3,700		6,100		11,000	23,000
Length of base plate in mm.	600	760	790		1,370		2,700		Depends on the connection with the motor.	
Breadth „ „ „	1,020	1,020	1,220		1,500		2,130			
Height of machine from ground	900	900	1,055		1,780		2,075			
Diameter of driving wheel	350	400	500		600		900		...	...
Breadth „ „	150	300	300		450		560		...	...
Number of poles	6	6	8		10		14		30	40
Performance of machine with primary conduction loss of 3 per cent., transformation loss 5 per cent., and secondary loss of 2 per cent.	9,650	19,300	28,950		48,250		77,200		154,400	366,700
Glow lamps at 53 watts	165	330	500		825		1,320		2,640	6,300
„ at 78 watts	182	367	550		910		1,760		2,920	7,000
„ at 53 watts with loss per horse-power as above ...	10·6	11·1	11·2	11·7	10·9	11·2	11·0	11·3	11·3	11·45
„ at 78 watts	11·7	12·3	12·4	12·9	12·0	12·4	12·1	12·5	12·5	12·65
Horse-power required for full number of lamps, loss as above ...	15·6	29·8	44·1	42·8	76·0	73·6	120	116·5	233	550
Watts per effective horse-power at terminals	620	652	656	676	635	656	644	662	662	667
„ horse-power at lamps	530	588	600	620	576	600	587	600	600	607

With the machines A 3 and A 6 the first numbers give the values for driving the belts; the second for direct driving, the dynamo being coupled with the motor. A 1 and A 2 are only worked with belting; A 7 and A 8 only with direct connection.

produces electricity from hydrogen and oxygen gas by the intervention of platinum. The distinguishing feature of the new battery, to which we briefly referred last week, which has been designed to obtain large currents of electricity by means of these gases, is that the electrolyte is not employed as a mobile liquid, but in a quasi-solid form, and it is therefore named "Dry Gas Battery."

Each element of the battery consists of a porous diaphragm of a non-conducting material—for instance, plaster of Paris—which is impregnated with dilute sulphuric acid. Both sides of this diaphragm are covered with very fine platinum leaf, perforated with very numerous small holes, and over this with a thin film of platinum black. Both these coatings are in contact with frameworks of lead and antimony, insulated one from the other, which conduct the electricity to the poles of each element. A number of these elements are placed side by side, or one above the other, with non-conducting frames intervening so as to form chambers through which hydrogen gas is passed along one side of the element and air along the other.

One element, with a total effective surface of 774 square centimetres = 120 square inches, which is covered by 1 gramme of platinum black and 0·35 gramme of platinum leaf, shows an electromotive force of very nearly 1 volt when open, and produces a current of 2 ampères and 0·7 volt, or 1·4 watts, when the outer resistance is properly adjusted. This current is equal to nearly 50 per cent. of the total energy obtainable from the hydrogen absorbed in the battery. The electromotive force decreases, however, slowly, in consequence of the transport of the sulphuric acid from one side of the diaphragm to the other. In order to counteract this disturbing influence the gases are from time to time interchanged.

The battery works equally well with gases containing 30 per cent. to 40 per cent. of hydrogen, such as can be obtained by the action of steam or steam and air on coal or coke, if these gases have been sufficiently purified from carbonic oxide and hydrocarbons. The water produced in the battery by the combination of hydrogen and oxygen is carried off by the unconsumed nitrogen and an excess of air carried through it for this purpose.

REGISTERED DESIGNS FOR FIRE-PROOF RESISTANCE FRAMES.

TO meet the growing demand for resistance frames for regulating currents of electricity, W. T. Goolden & Co. have recently introduced some new designs of the same.

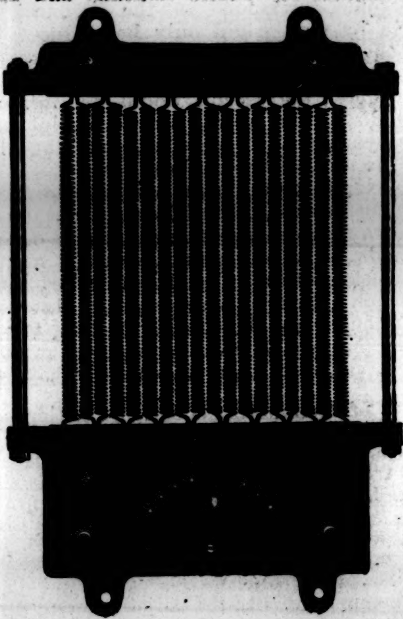
Two sizes are made, the largest about 1 foot 6 inches wide by 6 feet long, and the smallest about 1 foot wide by about 2 feet 6 inches long, the lengths of both varying, of course, according to the resistance they are required for. In the construction of the large pattern two cast iron "end frames" have wrought iron pins cast in, which carry porcelain insulators, the frames being connected by two side rods. On the porcelain insulators are hung the coils of wire, either German silver, platinoid, or galvanised iron, &c., and these are connected by screw connectors which admit of branch wires being taken from them to the regulating switch in centre. This regulating switch is an ordinary switch bar and handle, moving over a number of points fixed upon a slate disc, the whole being carried by a cast iron "bridge" piece, perfectly clear of the wire coils.

In the small pattern shown in the illustration, two cast iron end pieces and side rods form a rectangular frame, as in the larger pattern, but no pins or insulators are used. The end frames are cast hollow to receive slate tablets, the projecting edges of which carry the wire coils, and these are connected by screw bolts through the slate.

The bottom "end frame" has a semi-circular slot cast in, and the contact points are arranged therein, the switch bar being moved over these points as desired.

The small pattern is designed for dissipating 1,000 to 1,200 watts without becoming hot, and the larger pattern can be made for any current up to 8,000 to 10,000 watts.

A number of these frames are now in use, and giving satisfaction, the large pattern being used principally for shunt-wound dynamos, exciting currents for alternating machines, &c., and the small size for regulating transmission of power in motors, and for regulating the current between sets of accumulators charging in parallel, &c.



These resistance frames fully meet the requirements of the insurance companies, and in addition to being strong and substantially built, are of a neat and pleasing appearance.

ON THE ELECTROMOTIVE FORCE OF BATTERIES.*

(Note by Messrs. P. CHROUSTCHOFF and A. SITNIKOFF.†)

THE direct measurement of the electromotive force of batteries rarely gives figures agreeing with the value of this force calculated from the thermo-chemical data of the reaction accompanying the work of the battery. It is well known, on the other hand, that Thomson's theorem, which is used to calculate electromotive force, is found to be true, if modified in accordance with a thermo-dynamic consideration due to M. Helmholtz. This modification of the Thomson theorem, which may then be expressed by the formula

$$E = \cdot 043\, C \pm T \frac{d\, E}{d\, T}$$

(in which C = the heat of the reaction, E = the electromotive force of the battery), being strictly accurate, has been fully confirmed by subsequent experiments. But, being the expression of a very general relation, it admits of different interpretations of the phenomenon that intervenes to impede the total transformation of the chemical energy into energy of current. Thus we may suppose that the chemical energy is in general only partially transformable into electrical energy: only a portion of the chemical energy present would be *free*, whereas the rest could only be transformed into heat, the two portions coming under very distinct categories. This view of the question has been set forth by Mr. Braun independently of the theory of M. Helmholtz. On the other hand, we may search for the existence of real phenomena, intimately connected with the production of the current by batteries, phenomena that would tend to counteract the integral transformation of the chemical energy; these secondary phenomena might modify the "useful effect" of the chemical energy, part only of which would be free, but this time with reference to the definitive result. In general in chemistry, these two modes of interpretation lead to opposite conclusions: the first would tend to assign a double origin to the heat of reactions, one portion of which would correspond to the chemical potential, which in its turn could only be deduced from the thermo-chemical data by the aid of "coefficients of useful effect," taken from the value of the electromotive forces; the second would not introduce this absolute distinction of the transformable part of the chemical energy, and would attribute the differences observed to secondary complications.

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* *Comptes Rendus.*

† The Academy decided that this note, although exceeding the limits allowed, should be inserted in full.

When examining the notes published on this subject, we have been struck by the following considerations:—It is known that on the contact surfaces of the metals and liquids of a battery traversed by a current, a thermo-electric effect is produced, called the Peltier phenomenon; the energy produced or absorbed by the Peltier phenomenon being able to take the place of secondary heat, it is evident that we must find its numerical value in order to compare it to the term $\pm T \frac{dE}{dT}$ of Helmholtz's equation. A German physicist, M. Gockel, has established a comparison of this kind for a series of batteries, from which he obtained a negative result for the agreement of the absolute value of the Peltier phenomenon and the term $\pm T \frac{dE}{dT}$, although it establishes a coincidence for the sign of the energy. But the only important differences that he observed related to batteries containing salts of mercury, for which he made use of Thomson's thermochemical data. On calculating his results with the new data (Nerust, 1886) we were struck with the agreement between the electromotive forces observed and those that can be calculated by taking into account the Peltier phenomenon. This led us to undertake some measurements of electromotive forces, which we will now briefly describe.

The heat due to the Peltier phenomenon may be represented by a term $T \frac{dE}{dT}$ (in mechanical measuring), in which E represents the thermo-electromotive force of the combination in question. We see the analogy of this expression of the value of the Peltier phenomenon with the term $\pm T \frac{dE}{dT}$ of Helmholtz's equation, representing the difference between the chemical heat and the voltaic heat of a battery; we are thus led to ask whether these are two equivalent expressions of the same quantity, expressions which we should be justified in considering identical. It is evident that we could only do so on condition that the variation was in proportion to the temperature at the thermo-electric part of the electromotive force. M. Duhem insisted on the impossibility of establishing a similar identification *à priori*, owing to the absence of a known relation between the change of a system and its thermo-electric constants. Consequently we had recourse to direct observation. For this purpose we chose some batteries (examined by Mr. Wright), we determined their electromotive forces and the values of $\frac{dE}{dT}$ of the thermo-electromotive force at the different contacts of the metals, liquids and precipitates forming the batteries.

We employed a method of compensation, which does not differ in principle from the manner in which M. Bouty measured the difference of potential at the extremities of the capillary tubes to arrive at the determination of their conductivity (Annales de Chimie et e Physique, 1884); all our measurements, therefore, relate to open batteries. But in order to avoid absolute measurements, we compared, by substitution, the unknown electromotive forces to those of several normal elements—those of Gouy, Latimer-Clark and Helmholtz (solution of $Zn\,Cl^2$ at 8 per cent.). By adopting 1·433 volts at 22° for the Latimer-Clark elements, we obtained, on April 6th, 1888, Latimer-Clark = 1·433 volts; Gouy = 1·3919 volts; Helmholtz = 1·0822 volts; and, likewise, on August 15th, 1888, with the same elements, Latimer-Clark = 1·433 volts; Gouy = 1·3909 volts; Helmholtz = 1·0824 volts.

These values approximate pretty closely to the data of the authors, and were sufficiently constant for the object of our research between the beginning and end of the measurements in question. The variations of the thermo electromotive forces were measured in the same manner by M. Lippmann's electrometer, with batteries, containing the same metal at the two electrodes, separated by a long capillary tube, and maintained, one at 0° centigrade, the other at about 50° centigrade, in hot baths; the reading of the temperatures was taken to the tenth of a degree. We did not take into account the thermo-electrical variations at the contact of the metals and of the liquids, these quantities being unimportant in approximate valuations. Here are some examples:*

1. Case of the electromotive force observed being greater than the force calculated (Thomson's theorem); $Cu \mid sol.\ Cu\,SO^4 \mid sol.\ Zn\,SO^4 \mid Pb\,SO^4 \mid Pb$. E found = 0·61 volts at 20°.

Theory = 0·383 by adopting $Cu\,SO^4$, dissolved = 198 cal. 4, and Pb, S, O^4 = 216·2 cal.; $\frac{dE}{dT} = \cdot 00066$ volts per degree (between 0° and 50°) for the system $Cu \mid sol.\ Cu\,SO^4 \mid Cu$, and $\frac{dE}{dT} = -\cdot 00011$ volts for the system $Pb \mid Pb\,SO^4 \mid sol.\ Zn\,SO^4 \mid Pb\,SO^4 \mid Pb$.

We get from this, by M. Helmholtz's equation $E = \cdot 608$ volts, as was given by direct observation. We may remark here that we have always taken into account the polarisation, although very slight, which is observable with similar electrodes at the same temperature; thus we only quote observations in which the electromotive force of the battery and the thermo-electrical differences returned exactly to the initial values, after prolonged heating, a condition that limits considerably the number of batteries capable of being studied from this point of view.

2. Same category of batteries: $Hg \mid Hg^2\,Cl^2 \mid sol.\ Zn\,Cl^2 \mid sol.\ Pb\,Cl^2$† Pb. E found = ·540 volts at 20°

Theory = ·434 volts, adopting $Pb\,Cl^2$ (solid) = 82·8 cal., and $Hg^2\,Cl^2$ = 62·6 cal.; or, theory = ·33 volts adopting $Pb\,Cl^2$ dissolved = 76 cal.;

$$\frac{dE}{dT} = \cdot 00066 \text{ for the system } Hg \mid Hg^2\,Cl^2 \mid sol.\ Zn\,Cl^2 \mid Hg^2\,Cl^2 \mid Hg$$

$$\frac{dE}{dT} = \cdot 00009 \text{ for the system } Pb \mid sol.\ Pb\,Cl^2 \mid Pb.$$

We get from this $E = \cdot 50$ volts for $Pb\,Cl^2$ dissolved, and $E = \cdot 60$ volts for $Pb\,Cl^2$ solid; the value we found lies between the two.

3. Case of the electromotive force observed being less than the force calculated: $Pb \mid Pb\,SO^4 \mid sol.\ Zn\,SO^4 \mid Zn$.—$E$ found = ·500 volts at 20°.

Theory = ·697 volts, adopting $Zn\,SO^4$ (dissolved) = 248·5 cal. We find $\frac{dE}{dT} = \cdot 00076$ volts for the system $Zn \mid sol.\ Zn\,SO^4 \mid Zn$, and as before mentioned

$$\frac{dE}{dT} = -\cdot 00011 \text{ volts}$$

for the system $Pb \mid Pb\,SO^4 \mid sol.\ Zn\,SO^4 \mid Pb\,SO^4 \mid Pb$.

From this we get $E = \cdot 506$ volts.

4. Case in which the electromotive force has a different sign to the calculated force.

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[*] The liquids of the batteries were always normal (one equivalent = 1 litre). Sol. $Cu\,SO^4$ indicates a normal solution of $Cu\,SO^4$ for our observations.

[†] Solution saturated cold in a solution of $Zn\,Cl^2$.

Hg | $Hg^2 Cl^2$ | sol. K Cl | Ag Cl | Ag. — E found = ·060 volts at 20°.

Theory = + ·090 volts, adopting $Ag^2 Cl^2$ = 58·4 cal. For the system Hg | $Hg^2 Cl^2$ | sol. K Cl | $Hg^2 Cl^2$ | Hg, we find that $\frac{dE}{dT}$ = ·00068 volts.

And likewise $\frac{dE}{dT}$ = ·00016 volts for Ag | Ag Cl | sol. K Cl | Ag Cl | Ag.

From this we get E = — ·062 volts, which is identical with the value observed directly.

We have adopted 62·6 cal. for $Hg^2 Cl^2$. With the former value 82·6 cal. (Thomson), M. Gockel found the secondary heat of the battery Zn | sol. Zn Cl^2 | $Hg^2 Cl^2$ | Hg = 21 cal., whereas the Peltier phenomenon only gave 1·45 cal.; but on calculating the secondary heat with the new data, we find 2·0 cal. Likewise for the battery Zn | sol. Zn I^2 | $Hg^2 I^2$ | Hg, the secondary heat would be (with the former data) = 23 cal.; whereas the Peltier phenomenon only gives 4·45 cal.; but calculating with the new figures, we get the secondary heat 6·63 cal., which agrees pretty closely.

Lastly, recently M. Jahn, measuring the heat of the Peltier effect directly with the glass calorimeter, found it agreed with the secondary heat.

Thus for the battery Zn | sol. Zn SO^4 | sol. $Ag^2 SO^4$ | Ag, the theory (Thomson's theorem) indicates 78·34 cal.; we observe 69·25 cal. for the heat available for the current; but taking into account the heat of the Peltier effect we find 68·67 available.

Likewise for the battery Cu | sol. Cu SO^4 | sol. $Ag^2 SO^4$ | Ag; theory 29·72 cal.; observation 19·12 cal., and deducting the heat of the Peltier effect, we get 21·72 for the available heat.

We wished to draw attention to this conclusion, which springs from the various causes described; the complication of the electromotive force of the batteries, due to the Peltier effect, is of a nature to make up the discrepancy between the force observed directly and that calculated by means of Thomson's theorem. The Peltier effect gives a value of the same sign and the same order as this difference. Without wishing to assert that this is the sole cause of complication, we merely remark that the divergence in question does not bring to a calculation coefficients of a useful effect of the chemical energy measured by the calorimetrical way.

Thus the chemical energy would only be partly converted into electrical energy, owing to the intervention of secondary phenomena.

THE TELEPHONE COMPANIES AND THE POST OFFICE.

THE correspondence which has recently ensued between the Post Office and the telephone companies has once more directed attention, not only to the relationship which exists between the companies and the Department which has under its especial charge the conduct of the telegraph service of the country, but to the still more important question of the public service.

England was the first country to which the telephone was sent on its birth. It took root somewhat slowly; still it did take root, and although its growth was not so vigorous here as in America and other places not so freely burdened with restrictions as are we, it very soon became essential to both social and commercial life. Too large to be fairly dealt with by the parent company, or possibly, following the course of our friends across the water, with the object of securing imposts on concessions, subsidiary companies were formed, to whom was relegated the right of supplying the wants of the population of such districts in the shape of telephonic exchanges and telephone apparatus generally.

No sooner is success attained in this direction, than the Post Office push forward the Act under which a monopoly of the telegraphs was secured to that department, and, claiming and establishing the fact that the telephone is a telegraph instrument, restrict its use for public communication except under licence from the Postmaster-General—such licence carrying with it a tax regulated by the receipts of the company for such communications—the companies' operations being restricted each to a certain narrow field.

The next stage attained by the companies was that from which the present condition naturally springs. The exchange business had been narrowed down to a certain prescribed area within or around certain cities and towns. It was hardly to be expected that either the public or the companies would remain satisfied with such restrictive measures, and the Government were obliged eventually to recognise the right of the companies to an extended field—to a field, indeed, whose limit was that of the boundaries of the company. Each company thus acquired the right to establish for the public convenience means for carrying on telephonic communication from one end of their territory to the other. How rapidly the companies have availed themselves of these powers is clear, from the fact that they are now seeking to join hands and form the whole into one bundle of sticks, thereby affording to the public the power to use the telephone to its utmost limits, bounded only by the coast lines of the country.

It is to this last action—this combination of the companies—that the Post Office, in its capacity of guardian of the telegraphic interests of the country, objects. It is very broadly hinted that the Post Office has the power to withhold licences from the companies, and that the power may be exercised if circumstances not contemplated by the Department should arise.

We assume this is so, but we hardly look for the exercise of such power. Why should a Department established for the purpose of fostering and promoting telegraphic communication attempt to do any such thing? True it is that the Post Office was, on the acquisition of the telegraphs, granted a monopoly covering all telegraphic public correspondence; but that monopoly was granted not with the desire to check telegraphic enterprise, but rather to protect the Department against vexatious and unremunerative opposition —a proper step in the interests of the national purse. Telephonic communication was at that time unthought of. Had it been in existence the State would have found it as necessary to acquire it as to purchase any one of the telegraph companies. It has come to life since that period. The Post Office, from rejecting it as a scientific toy, has found it necessary to bring it within the realm of a telegraphic instrument, and now to restrict its use. For what reason? What is their doctrine? Would they have us believe that that which they, by their own action, admit to be good and desirable for A and B individually, is not good for A and B collectively? We fear there will be some difficulty in persuading the public that this is so. The principle of inter-communication has been admitted: it has been adopted, taken root, and become essential to our commercial and every day life demands. If it is good for Manchester to be able to hold converse with Liverpool, or Newcastle with Hull, it is equally good for London to speak Birmingham or elsewhere. Why should a line be drawn between the Midlands, the North, and the South? Where is the logic of such a division? We cannot believe that any branch of the Government—Post Office or Treasury—can in reality contemplate any such step. It would be a folly too evident to contemplate. However much the Telegraph Department of the State may dislike it, the amalgamation, or that which is tantamount to it, will take place, and may practically be regarded as *un fait accompli*.

Let us for a moment consider the aspect which continued opposition to that which the telephone companies desire must assume. Why should a Department, whose *prima facie* duty it is to provide all possible facilities for telegraphic communication throughout the country, adopt a course having for its effect the very opposite result? People will naturally begin to ask themselves, Is it that the Government desire to check the progress of telephonic enterprise? Is it that they fear telephonic communication will detract from the telegraphic revenue? It cannot be that any such opposition is necessary for the good of the community. It should be borne in mind that the telegraphic communication of the country is a trust reposed in the Government, and it is for the Government to use that trust for the good of the community. It is possible our arguments may dovetail into those of the telephone companies, but we are not viewing the case from their standpoint at all; we are regarding it purely from a public point of view. It has not been our *rôle* to favour the telephone companies with praise for their management—rather the reverse; but the telephone has become a necessity of commerce, and whether it is in the hands of the companies or of the Government, it is desirable it should be set free, as far as is possible, from those trammels which have for so long a period weighed it down and dwarfed its application. How much the companies themselves are to blame for this result, or how much the Government may take credit for, we are not prepared to discuss at this moment. That it has not been so liberally handled as it might have been goes without saying. Many poeple would be glad to avail themselves of the advantages of the telephone at the present time could they obtain the instruments at a reasonable price, having regard to cost of production and the near approach of the lapse of patent rights. How far the enforced taxation to which every exchange subscriber has to submit in order to enable the companies to meet the licence fee imposed by the Government has militated against the more complete development of the exchange system is a question difficult to determine. Naturally it will have had some effect. As the case now stands we have the telephone companies making a profit and paying a tax to the Government. Were the undertaking in the hands of the latter, surely we might look for amelioration in some degree in this respect. We have never sought to hide the fact that in our opinion the telephone system should form a part and portion of the country's telegraph system, and that it should be controlled and managed by that department to which was given exclusive rights for that purpose; and we go further than this, and say, as we have said before, that eventually this must be so, unless the Government intend to abandon the mandate given them and allow the telegraphic as well as telephonic correspondence to pass into other hands. We cannot think the Post Office authorities are blind to this. If the telephone interests, so far as public communication is concerned, are eventually to be absorbed by the Public Telegraph Department, why defer the day for doing so? Why, at all events, withhold from the companies that which they and the public acknowledge as a need of the day?

KILLED BY AN ELECTRIC SHOCK.

AN inquest was held on Thursday week at the Castle, Woolwich, on the body of John Connelly, aged 31, a pensioner from the Royal Engineers, who was killed whilst at work at Siemens's Telegraph Works, Charlton, by an electric shock.

James Bloss said he was coiler at Siemens's. At half-past one on Tuesday afternoon he went through the cable floor to the electric light shop. On the floor of the latter shop he found deceased apparently dead.

Henry Percy Haynes said he was a clerk in the electric light department at Siemens's factory. Deceased was employed as a labourer. At the dinner hour on Tuesday witness was in his office, when the last witness called his attention to a man lying on the floor of the electric light shop. He ran out, and found him lying on the floor with Sir William Thomson's astatic voltmeter lying on his hand. It had been on the bench before, and did not require any attention from deceased. Witness sent for medical aid, and Dr. Hughes came and pronounced the man dead.

Alfred Dykes said he was an electric engineer in the employ of Siemens' Bros. at Charlton. Deceased came on May 20th and was employed to mind the engine in the electric light room. He seemed well up to his work and had to keep the speed of the engine constant. The engines were driving two dynamos in the light shop. When witness left at one o'clock, he told deceased to keep the engine running steadily, and that if anything went wrong to stop the engine, and not to attempt to touch any of the electric machines. The astatic voltmeter was used for measuring the pressure at the terminals of the dynamo. Deceased had no business at or near the meter, in fact witness had several times warned him not to touch it. The strength of the pressure at the time was 1,000 volts. It would not be safe to touch the instrument with a hand on each terminal. One terminal might be touched, but if both were touched death would be instantaneous. He believed the deceased touched the instrument with both hands, thus disobeying instructions. Deceased knew it was dangerous, in fact fatal, to touch the instrument. He could not say whether he touched the meter for the purpose of committing suicide. When the instrument was found on deceased, the wires had been torn down; but one wire was connected by a current with the instrument.

Edward Laukert, chief of the electric light department, said he engaged deceased at 5½d. per hour as a labourer. He considered it proper that a labourer should mind an 8-horse engine. If one of the terminals of the instrument (the left hand terminal) had been covered with a non-conducting material, the accident would not have occurred; but the firm preferred to use the instrument precisely as they had it from Sir William Thomson. There were plenty of other dangerous points in the same and other rooms. They never had a similar accident on the works during the 22 years he had been employed there.

Dr. Hughes, Albion Road, Woolwich, said that he was sent for and found deceased dead in the light shop. There were violet coloured streaks up the right hand, with a perforation in the palm where the fluid entered. In the left hand were three perforations where the electric fluid went out. The postmortem examination showed that an electric shock had gone through him. The heart and all the organs were healthy. He died instantaneously from a shock of electricity.

Dr. Coleman, Woolwich Common, said he attended to watch the case for the Home Office with a view of steps being taken to prevent a recurrence of such accidents. His experience in the Arsenal showed that in 99 out of every 100 cases, accidents arose from carelessness on the part of the *employés*, who were very prone to remove all and any guards.

The Coroner said that deceased had no business to have left his post at the engine to have gone, from curiosity or otherwise, to the instrument.

The jury returned a verdict of "accidental death," and attributed no blame to the firm.

ELECTRICAL EXHIBITS AT THE WINDSOR SHOW.

THE fiftieth annual exhibition of the Royal Agricultural Society of England, now being held in Windsor Great Park is likely to be a memorable one, both on account of the unprecedented number and excellence of the exhibits and of the unparalleled amount of the receipts from admissions and other sources. A number of the engines exhibited are shown with dynamos attached, and in a few cases the stands are lighted with incandescent lamps. The most prominent electrical display is that made by Messrs. Priestman Bros., who exhibit three types of their oil engines (Priestman's, Hume's, and Etéve's patents), using common mineral oils. A 4 H.P. engine, of horizontal type, is exhibited driving a 50-light dynamo, showing the utility of the engine for this purpose, the dynamo, set of accumulator cells, and a number of fittings being supplied by Messrs. Lea, Sons & Co., of Shrewsbury. The fittings are specimens of the artistic "metalli-floral" series, in wrought iron and polished copper, which is the speciality of this firm. Another oil engine shown by Messrs. Priestman Bros. is 6 H.P. nominal, portable type, the special feature of this exhibit being the application of this motive power as a portable engine, and the makers claim it to be the first introduction as such to the public. In this form it is useful for many purposes, especially for farmers, and in all cases where the portable steam engine has hitherto been used, and as this engine requires no driver and but little attention it is likely to answer its purpose well.

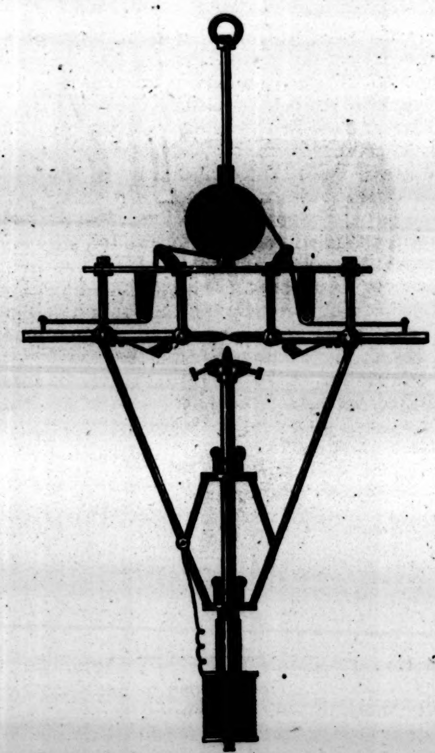
Another good electrical exhibit may be seen at the stand of Messrs. Dick, Kerr & Co., in connection with the Griffin gas engine, which is shown driving a dynamo to supply about 20 incandescent lamps. The Royce machine and all the fittings are supplied from the Acme Electric Works. Amongst the gas engines a prominent show is, as usual, made of the Stockport by Messrs. J. E. H. Andrew & Co., additional interest attaching to this exhibit from the fact that the gas used is produced by a water gas plant adjoining. Atkinson's patent Cycle gas engine, which has come off so successfully in recent trials, both here and in America, is also exhibited. Amongst steam engines Messrs. Robey and Co. make a feature of their improved coupled compound horizontal fixed engine with patent automatic trip expansion gear, as specially suitable for large permanent electric light installations; and their vertical high-speed engine, which they have specially designed for working electric light machines on board ship and in flour mills, &c., the space required being very little. An interesting item at the stand of Messrs. Fowler & Co. is a 25 H.P. compound horizontal engine, constructed to the order of Colonel North for the electric light installation at his house at Eltham. It is fitted with Hartnell's automatic expansion gear on both cylinders, controlled by one governor, and with drop sight lubricators to all the bearings and sight feed lubricators on the steam chest, having been specially designed for electric lighting or work where steady running for long periods is essential. Although on a much smaller scale, we believe this engine is identical in design with those at the Brompton station of the House-to-House Electric Lighting Company. Messrs. Fowler & Co. also show a new high speed engine (Scott's patent) specially suited for driving dynamos and other quick-driven machinery. It is an inverted compound tandem engine (single acting), the cylinders being 7 inches and 12 inches diameter by 9 inches stroke, and is of somewhat peculiar principle, having the boiler steam constantly on the upper side of the high pressure piston, and also on the underside during part of the up-stroke until the piston covers a port in the cylinder side, when a sharp cut-off takes place and expansion begins, which is continued during the down-stroke in the low-pressure cylinder. By using the piston to obtain the cut-off in the H.P. cylinder only one valve rod and eccentric are required to obtain a free distribution of steam, as is shown by the excellent diagrams taken. The excess of pressure on the top of the piston for the latter half of the up-stroke balances the momentum of the pistons, &c., and prevents knocking, so that it runs at 400 revolutions very quietly and smoothly. The governor is contained in the flywheel, whence it operates a valve regulating the supply of steam to the under-side of the H.P. piston. Excellent engines for electric lighting purposes are also shown by Messrs. Marshall, Sons & Co., Messrs. Ruston, Proctor and Co., Messrs. Ransomes, Sims and Jefferies, and Messrs. C. Burrell & Sons.

We believe the only firm of electricians who are actual exhibitors is that of Messrs. Immisch & Co., who have on view a counterpart of the electric carriage which they constructed and sent out by Mr. Volk to Constantinople for the Sultan of Turkey. It was intended to have this shown in motion, the accumulators being recharged at intervals at one of Messrs. Immisch and Co's. charging stations on the river, but we understand a difficulty arose in the way of leaving and re-entering the show yard. An interesting object at the stand of Mr. C. L. Hett is a small Pelton wheel, the construction of which was referred to in the description of the large electrical transmission plant at Virginia City, Nevada, in our issue of June 14th. Mr. Hett, we understand, is prepared to give to enquirers any further information as to the supply of these waterwheels. Mr. H. J. Rogers, of Watford, exhibits an Elwell-Parker dynamo driven by a gas engine supplied with gas from his "Koh-i-noor" gas producer, suitable for lighting country houses and farm buildings.

CHAPMAN AND DEARING'S ARC LAMP.

IN this lamp there are two positive carbons, which are placed horizontally, meeting in the centre, and the single negative carbon is placed at right angles to these.

The lower part of the frame is insulated from the horizontal guiding tubes, and the top plate and the two portions of the positive carbons are fed together by the action of a spring, coiled in a drum, and are always kept in contact.



The negative carbon is fed by the pressure of a spring inside the holding tube pressing the carbon against the abutments near its point, or it may be fed by any suitable clutch arrangement. It is kept in contact with the positive carbons by means of a light spring, until the passage of the current, which enters by the binding screws, through the standards to the positive carbons, through the negative, and round the solenoid, thus acting on an iron core attached to the vertical tube, and so striking the arc.

The advantages claimed from the manner in which the inventors place the carbons in this lamp are :—

Firstly.—For street lighting. By placing the lamp in a certain position, they consider that they are enabled to light the centre space between two lamps effectively, as the light is distributed horizontally, and is well diffused. This allows of placing lamps at a less height than the ordinary vertical carbon lamps, and by reason of the arc always remaining in a fixed position at the top of the lantern, no heavy shadows are produced as the carbons burn down low, and the lamps can, of course, be made to run any reasonable time with one set of carbons.

Secondly.—For focussing or search light purposes, an absolutely fixed position of the arc by the most simple means.

Thirdly.—Lamps can be constructed to take heavy currents, without danger of carbons splitting by overheating.

These are the principal points to which the inventors, who are desirous of placing this lamp on the market, lay claim.

THE COMPOUND WINDING PATENTS.

King, Brown & Co., v. Anglo-American Brush Electric Light Corporation, Limited.

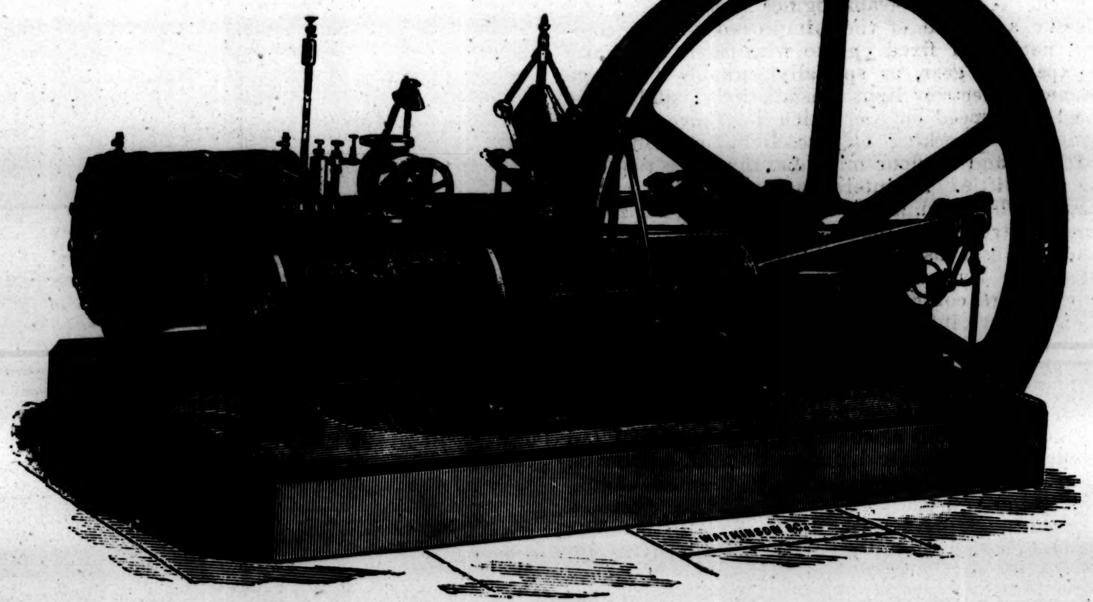
In the Court of Session, Edinburgh, on Wednesday, Lord Trayner gave judgment in the action by King, Brown & Co., Rosebank Electric Works, Edinburgh, against the Anglo-American Brush Light Corporation, Limited, 6, York Place, Edinburgh, for reduction of letters patent. His lordship found that the Brush Company's machine was anticipated by Varley's machine both by publication and usage, and also that the final specification is larger and different from that claimed in the provisional, and that accordingly the Brush Company's patent is invalid. A full report of the judgment will appear in our next number, which commences a new volume.

ENGINES FOR CENTRAL STATION LIGHTING.

Now that central stations for electric lighting are being formed in every direction the question of the prime motor becomes one of considerable importance, and the necessity of having an engine of durability and reliability is apparent. Our illustration represents a pair of compound engines of the "Sandon" type, constructed by Messrs. Browett, Lindley & Co., of Salford, Manchester, and is taken from the photograph of a pair having 12-inch and 20-inch cylinders of 24-inch stroke, set to run at 100 revolutions per minute and develop 120 H.P.

Engines of this size and larger (up to 250 H.P.) are particularly suitable for central electric lighting stations, while the smaller sizes in which they are made (as low as 25 H.P.) are in successful use for smaller installations. Several pairs like the above illustration are in use in London, Barcelona, Russia, San Sebastian (South America), and others are now in course of construction (in these cases fitted with condensers) for towns in Sweden and elsewhere.

It will be seen that in design the general proportions are both massive and graceful. The high pressure cylinder is fitted with the "Rider-Lindley" patent automatic expansion gear, which is largely used by the firm on all types of engines with most satisfactory results as to uniformity in speed and economy in steam. With this gear a range of cut-off is obtained wide enough for all purposes, and within the limits between which modern engines with high pressure of steam work ($\frac{1}{18}$ to $\frac{1}{3}$ stroke), a well defined diagram is produced, so that, so far as the distribution of the steam to the cylinder is concerned, the best results as regards economy are obtained, and the extreme simplicity and direct action of the whole gear, added to the well-known sensitiveness of the Porter governor (in the construction of which Messrs. Browett, Lindley & Co. have also introduced some improvements) combine to make this valve-gear thoroughly satisfactory and reliable, at a very slight extra expense over hand-variable expansion gear, the cost being soon saved by the economy of fuel effected.



The "Sandon" Compound Engine.

Another important point, efficient lubrication, is also carefully provided for. The steam is greased by a continuous sight feed lubricator which is found to keep the valves and cylinders in a splendid condition with the most moderate consumption of oil. The crank-pin is oiled by an adjustable cup fixed on a polished standard and delivering into a centrifugal oiler, and the crosshead pin is bored hollow and oiled from cups at its end.

The shaft, cranks and crank pins, piston rod and valve spindles are all of mild steel and the joint pins are of steel, hardened and ground up true. All nuts and set screws have case hardened heads, and phosphor bronze and gun-metal are used for all brasses, those of the main journals being adjustable sideways by screws and wedges to take up the wear in the direction where it must occur most.

Messrs. Browett, Lindley & Co. were early in the field as makers of special engines for electric lighting purposes, having built hundreds. The experience thus gained has been turned to good account in many of these minor details so essential to success.

THE SCOTCH COMPOUND-WINDING CASE.

JUDGMENT in the important case of King, Brown & Co. *v.* Anglo-American Brush Corporation, was delivered by Lord Trayner last Wednesday. As will be seen from our other columns, Haddan's patent is declared void, both on account of the enlargement and difference of the original provisional specification, and by reason of Varley's machine and his specification being decided as prior publication and user. Our remarks must be brief, because at the time of writing we have not a copy of the judgment.

As we have frequently pointed out, the only chance the Brush Company had was to mystify the Court, a result which it is unfortunately very difficult to avoid. In this case the Brush people were at considerable disadvantage, because Lord Trayner preferred to go as thoroughly as possible into technical details, instead of following the practice of taking refuge in some purely legal point and giving his decision on that. Moreover, their leading counsel was raised to the Bench before making his speech.

Messrs. King, Brown & Co. really owe their success almost entirely to Mr. Graham Murray, who worked up his case to the last detail, and who is certainly a master of the art of cross-examining expert witnesses.

The Brush experts had certainly a very difficult task in making out that Varley meant all sorts of queer things. It was not a little strained to say that in 1876 all the curious windings of which many of us had never heard were in common use; especially in the face of Haddan's own specification of 1878, in which series is referred to as the usual winding. Under Mr. Murray's hands the atmosphere cleared up, showing series shunt winding in each case.

The commutator question was very interesting from a legal point of view, but we should have been sorry if the patent had been upset on that ground alone, as the real question was whether Brush had invented series shunt winding. The claim that he invented constant potential winding was never urged at the trial, being obviously untenable.

We have always failed to find the obscurity in Varley's specification. It is not all in modern language, and there is a slip about the number of bobbins in one place; but the specification is a perfectly clear description of a machine which, at that date, was exceedingly clever, and his arrangement of his circuits to secure a "permanent field" shows wonderful forethought in design.

A facetious correspondent writes:—"The case must not be considered in the least settled. It goes before the Scotch Court of Appeal next; we do not know its name, but think it is a Synod or Kirk Session. It may find anything, but will probably decide that Edison invented compound winding, or that it has never yet been described so that a workman could use it. The last is unlikely, because it is true."

Telegraphy in the Argentine Republic.—The increasing commercial activity in this republic is shown by the advances which have been made in the number of telegrams dispatched. The figures were 567,632 telegrams in 1884; 658,461 in 1885; 821,378 in 1886; 816,054 in 1887; and 851,353 last year. This shows an increase in five years of about 60 per cent.

NOTES.

Electric Lighting in Paris.—The works in connection with the district handed over to the Marcel Deprez Company are only progressing slowly and will not be completed within a month. The Continental Edison Company recognising the fact that the lamps placed by them on the great boulevards were not things of beauty have substituted others for them, but the new article is no more artistic than the old. Complaints are made that the new gas lighting of the Rue de la Paix and of the Avenue de l'Opera is unsatisfactory as regards the distribution of the light on the ground. The electric light, it is maintained, would have been found far better. The electric light was inaugurated in the gardens of the Palais Royal on the 15th inst. The Popp Company has installed, at the corner of the Avenue de l'Opera, the first regulators for the lighting of the Boulevards.

British Association Screw Thread Dimensions.—All connected with the manufacture of electrical instruments must be aware of the difficulty that has existed in having some recognised standard for the dimensions of small metal screws, and we are glad to find that the well-known firm of screw makers, Davis and Timmins, Limited, of 24, Charles Street, Hatton Garden, have decided to adopt the British Association standard dimensions, and to keep in stock a great variety of the various sizes. The Postal Telegraph Department were the first to adopt this standard, and it is somewhat surprising that many of the leading electrical firms, excepting when executing orders for the Post Office, still retain their own particular screw threads. In spite of this, there is no doubt that before long the B.A. screw will become as general for small work as the Whitworth screw is for large work, and the mere fact of Davis and Timmins, Limited, stocking the various sizes will go far towards getting these threads generally adopted, especially as it would seem there is already a growing demand. If we remember rightly, Mr. A. Le Neve Foster, who has the management of their works, was one of the gentlemen appointed on the British Association screw gauge committee. This should be a guarantee that the correct dimensions are strictly adhered to, as without this uniformity cannot be attained.

Electric Lighting in St. Saviour's District.—At a meeting of the Board on June 19th the Paving and General Purposes Committee reported that they had considered the letter from the Board of Trade, requesting to be provided with a list of streets in which, in the opinion of this Board, the London Electric Supply Corporation should be compelled to lay mains within a specified time. The committee recommended the following list of thoroughfares should be sent to the Board, viz.:—Boro' High Street, Southwark Bridge Road, Blackfriars Road, Southwark Street and Great Charlotte Street, and stated that they had instructed the Surveyor to meet Mr. Courtney Boyle, the Assistant Secretary to the Board of Trade, upon the subject, and as to the amount of deposit to be made by the undertakers. The report was adopted.

Electric Light on Steamers.—The electrical installation on board the new twin-screw steamer *Augusta Victoria*, running between Hamburg and New York, is said to be exceptionally well arranged. The plant consists of four Schuckert dynamos, driven by four Vulcan engines, supplying 800 16 C.P. Siemens and Halske lamps distributed throughout the vessel. In the dining saloon are a great number of small electroliers, each holding three lamps of opalescent glass. Each cabin is provided with a single lamp encased in a cream-coloured globe, giving it much the appearance of a miniature arc lamp. The dynamos give 300 ampères and 60 volts at a speed of 450 revolutions per minute.

Electric Light for the Albert Institute, Dundee.—A meeting of the Free Library Committee was held in the Albert Institute last Friday to receive tenders for fitting up the electric light in the building. Fourteen offers were submitted from the principal electricians in Scotland and England, and the Committee remitted them to Mr. Bryson, Glasgow, and Mr. W. Alexander, City Architect, to consider and report upon them to an early meeting of the Committee. We now understand that Messrs. Paterson and Cooper have secured the order. The cost of the installation will probably amount to £2,000.

The Late M. Planté on Storage Batteries.—The news of the death of M. Gaston Planté has been received throughout the country with feelings of the deepest regret. It is strange that, although his genius and ability were universally recognised, so little is known of his very able book, entitled, "The Storage of Electrical Energy," which contains a description of all his experiments with voltaic batteries, which finally led to the well-known form of Planté cell. Besides his experiments with all the common metals as voltaic couples, there are extremely interesting articles on the discharge of high-tension currents and globular lightning. It is doubtful if this latter subject has ever before been treated so completely, or with so many well-authenticated instances, which stands beyond dispute. The book cannot be too strongly recommended to all who have to do with secondary batteries, as it contains notes by the original inventor on the practical management of accumulators, and explains all the small but important difficulties which are so often met with, but which may be easily remedied and avoided by a little knowledge of their theory.

Barnet Electric Lighting.—Matters do not seem to progress much more smoothly between Mr. Joel and the Barnet Local Board now than they did formerly. Complaints are rife respecting the lateness of the hour of turning on the current, one private consumer declaring that he invariably has to light his gas before he could get his supply of electrical energy. The new machinery should have been in working order by Monday last, and we trust that when the plant has fairly settled down to its duties, we shall hear no further grumbling respecting the electric light in Barnet.

Bristol and the Electric Light.—Mr. Preece's report on the scheme for introducing the electric light into Bristol is described in the *Bristol Mercury* as dealing largely with generalities, somewhat vague, and as a rather academical treatment of the subject. He thinks that it would be far better that the proposed installation should be entirely in the hands of the Corporation, and the alternating current machine and transformer system is mentioned with favour. Coal can be obtained in Bristol at about half the price paid in London.

Electric Light for Edinburgh.—At Monday's meeting of the Edinburgh and Leith Corporations Gas Commissioners notice of motion was given that it be remitted to the Works Committee to consider and report as to what attitude the Commissioners should assume towards electric light companies proposing to supply electric light and power for the citizens of Edinburgh.

Electric Lighting for Dublin.—The arrangements for the introduction of electric lighting by the Corporation are being completed. The system by which it is proposed to light a number of the principal thoroughfares has been submitted to the engineer appointed to prepare the estimates. The report of the Government Inspector has not yet been prepared, but will be soon submitted, and the installation, it is expected, will be commenced within the next few months.

It is expected that Messrs. Edmundson & Co., of Dublin, will be given the commission for electrically lighting the new Science and Art Museum and National Library, Dublin.

Electric Lighting in Manchester.—A Manchester daily speaks in the following terms respecting the electric light in that great commercial centre:—"Manchester will lag behind other great cities in the race of electric lighting because she has her lighting in her own hands. That is the somewhat paradoxical moral taught by the statements made at the annual meeting of the Manchester Edison-Swan Company, Limited."

Electric Light Wanted.—All the gas in Erith and Belvedere, supplied from the West Kent Gas Company's Erith Gas Works, was cut off from 8.45 till about 9.30 on Monday night, causing the utmost inconvenience to all the consumers. It might also have been the cause of accidents on the railway as, of course, the signal lights went out too.

Electric Lighting at Southsea.—A temporary installation of the electric light has just been established by way of experiment at Messrs. Brickwood's Esplanade Hotel, Southsea, the machinery and apparatus having been supplied by Messrs. Laing, Wharton and Down for the South Hants Electric Supply Company, Limited. The installation was used for the first time on Saturday evening, when two arc lamps of 1,200 C.P. each illuminated the entrance to the hotel and dining saloon, and two similar lamps lit up the apartment in admirable style, the steadiness of the light being greatly admired. Two small incandescent lamps of 32 C.P. each lit one of the staircases. If the present experiment should prove satisfactory, Messrs. Brickwood will, in all probability, adopt it permanently.

Opening of the Telephone Exchange at Coventry.—On Monday night the National Telephone Company, Limited, formally celebrated the opening of a telephone exchange in the city by a gathering at St. Mary's Hall, at which the Mayor (Alderman Tomson) presided. There was a large attendance, including many members of the City Council and the leading citizens. The Mayor spoke of the utility of the telephone and its recent development, and said he had that evening sent and received messages through the telephone to and from the mayors of Bradford, Birmingham, West Bromwich, Walsall, Burton and Sheffield, and in each case he had heard their congratulatory speeches most distinctly, and he believed they had heard what he said to them in return with equal plainness. Mr. A. Coleman (the general manager) afterwards delivered an explanatory address, and the Mayor subsequently declared the telephone exchange open.

An Addition to Telephonic Literature.—We have received the first number of the *Telephone*, published in Chicago. "The special feature of the *Telephone*," says the publisher, will be its treatise on the telephone, that most useful and yet least understood invention of modern utility. It will be the aim of the publisher to put into the hands of the public a paper that will be understood by those who have not made the subject of electricity a special study.

Telephonic Progress.—The South of England Telephone Company is making rapid strides in the extension of their system through East Kent. The line between Ashford and Canterbury is now well advanced, and in five or six weeks Ashford will be connected up. Progress is also being made from Faversham towards Chatham, taking in on the way Sittingbourne. From Chatham the company will ultimately, and, we are informed, at no very distant date, carry a line on to Greenwich, and thus get connection with London. Within the next two months Deal will be connected with the system through Sandwich. This will be an enormous convenience to the district, and will, practically, complete the local circle. The company have in Mr. Burden, the district superintendent, a very zealous officer, and it is due to a great extent to his energy that so much progress has been made with the system in East Kent.

Curiosities in Telephony.—It is said if all the telephone wires in use in America were stretched in one continuous line, they would reach seven times round the earth; and if all the messages transmitted every day had to pass through one set of instruments, and occupied two minutes' time each, 10 years would be required to transmit them all.

What is it?—The *Pall Mall Gazette* refers to Sir William Thomson's *electroxtac* volt meter. Sir William will probably be desirous of knowing what it is.

The Electric Dog-Cart at the Windsor Show.—After the parade of the cattle before their Royal Highnesses the Prince and Princess of Wales and the Royal Family at the Agricultural Show on Wednesday, his Royal Highness was graciously pleased to order the electric carriage of Messrs. Immisch & Co. to be brought before him by a member of the firm, who explained the principle and action of this mode of locomotion. Their Royal Highnesses appeared greatly interested with the simplicity of the details, and at the ease with which the carriage is driven and guided, the motive force being supplied to the accumulators by one of the Immisch Electric Launch charging stations now lying in the Thames, off Windsor.

Electrical Tramways in America.—Electric tramways are multiplying rapidly in the States. The Thomson-Houston Company has just closed contracts for several new lines, totalling between 20 and 30 miles in length. Other companies are equally busy, and it would be almost safe to say that by the time we have 10 miles of track for passenger traffic worked electrically in this country there will be nearly 100 times this length in successful operation in America.

Removal.—The Walsall Electrical Company has removed to new offices and show rooms at 16, Bridge Street, Walsall.

Walsall Electrical Company.—This company has just issued a new list of electric lighting appliances, including voltmeters, lamp-holders, switches, cut-outs, and fittings.

Edison Lamps.—Some alteration in prices of lamps have been made by the Edison and Swan United Electric Light Company, particulars of which are given in a notice dated 1st July.

Birmingham Electrical Exhibition.—Novelties in connection with the approaching Exhibition continue to be added to the programme, the latest being a model coal mine, underground, the visitor descending by a real colliery lift. In connection with this it would be very appropriate to have a miners' lamp competition. The United Electrical Engineering Company will also furnish the necessary equipment for a telper line inside the building.

The Proposed Electrical Exhibition at Edinburgh.—A committee has been appointed to consider the question of the most suitable site, and to report at a future meeting of the promoters.

What Does it Mean?—The Brush invention of the word "bifurcation" was a stroke of genius of a foggy kind. We don't yet know what it means in contradistinction to "diverting," but perhaps it has something to do with the schoolboy's definition of a junction as where two roads separate, or salt as what makes meat taste nasty if you don't put any on.

Lightning Conductors.—This being our Index number, we are compelled to leave over Mr. Varley's contribution to the above subject until our next issue.

The Electric Sugar Swindle.—Sentence was delivered at New York on the 21st inst. on W. E. Howard, the electric sugar swindler. His punishment is nine years and eight months' penal servitude.

Chinese Telegraphs.—The telegraph lines across China from Shanghai to the western provinces has just been completed to Momein.

Perim-Obock Cable.—The French Government has agreed to grant to the Eastern Telegraph Company a subsidy of 37,500 francs per annum during 20 years for the laying and working of a submarine telegraph cable which will connect Perim with Obock, the French Protectorate on the African Coast of the Red Sea.

SS. "Silvertown."—The India-Rubber, Gutta-Percha and Telegraph Works Company has just received a telegram from Mr. Matthew Hamilton Gray, Engineer-in-charge, saying that the cable steamer *Silvertown* had successfully removed three faults from the cables connecting Dakar (Senegal) with Teneriffe, without interrupting the working of the lines. As one of these faults was in the neighbourhood of Teneriffe and the other two near Senegal, some 800 nautical miles southward, and the work was carried out in about ten days, those engaged in the operations are to be congratulated on their success. The *Silvertown* is expected to arrive in London on 5th prox.

The North Woolwich Cable Works.—We are informed that Henley's Telegraph Works Company is shipping 68 knots of submarine cable to the West Indies, and also manufacturing a length of submarine cable for Denmark. The Halifax-Bermuda cable is also being made by this company, whose works just now present a very busy appearance, as in addition to the submarine department they are working night and day on vulcanised India-rubber, electric light, and telephone cables. These covered wires are in great repute, and, we think, deservedly so.

NEW COMPANY REGISTERED.

Electric Trust, Limited.—Capital, £60,000 in £10 shares. To construct and carry out works, machinery, and apparatus for public and private electric lighting, and to produce, store, transmit, and use electric magnetic or other force. Signatories (with 200 shares each): Spencer Chadwick, 17, Parliament Street; H. Sampson King, Founders' Hall, E.C.; J. K. Douglas Mackenzie, C.E., 15, Great George Street; C. E. Masterman, Alsager, Cheshire; H. C. Masterman, 59, New Broad Street; W. R. Renshaw, Kidsgrove, Stafford; E. R. Robson, 9, Bridge Street, Westminster. The signatories are the first directors; qualification, £2,000 in shares or stock; remuneration, £50 per annum, multiplied by the number of directors for the time being. Registered 24th inst. by Hughes Masterman and Rew, 59, New Broad Street.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Crompton Electric Supply Company of Australia, Limited.—An agreement of 24th inst. between George Harrison and Alfred Herbert Whiffen, of Sydney, electric light engineers of the first part, and Crompton and Co., Limited, of the second part, and this company of the third part, states that for some time past Messrs. Harrison and Whiffen have carried on business as electrical contractors in Sydney and elsewhere in Australia on their own account, and as agents of Crompton and Co., Limited. This company will purchase the goodwill of the said business as from 1st inst. for £1,000 in fully paid "B" shares, and the plant, machinery, stock-in-trade, or will be purchased at a valuation. The English Company agree to grant to the Australian Company the sole right to represent them in New South Wales, Victoria, South Australia, Western Australia, Queensland, and Tasmania. This company will issue to the English Company £1,500 in fully paid "B" shares.

An agreement of June 24th between Messrs. Harrison and Whiffen and this company, provides for the appointment of the former as managers. Their remuneration is to be a sum equal to 6 per cent. upon the gross receipts until in any year the same shall exceed £20,000, and 5 per cent. upon the gross receipts over £20,000 and under £40,000 per annum, and 4 per cent. upon the gross receipts over that amount. Provided always that the gross receipts under any one contract shall only be calculated at the rate of 5 per cent. when the receipts under such contract are £10,000 or upwards, and only 4 per cent. when £20,000 or upwards. This amount includes office and clerical expenses in Sydney.

British Electric Lighting Company, Limited.—A contract dated 18th inst., between this company and Messrs. Wilson, Bristows and Carpmael, of 1, Copthall Buildings, E.C., solicitors, filed on the 19th inst., states that by a scheme for the liquidation of the liabilities of the company by arrangement with its creditors, and for the resuscitation of the company, sanctioned by an order of the Court, dated 26th September, 1888, it was provided, amongst other things, as follows :—

"The respective unsecured creditors of the company shall respectively accept fully paid up preference shares, carrying 10 per cent. per annum interest for amounts equal to 50 per cent., or one half of their respective debts or claims against the company, in full satisfaction and discharge of such debts and claims respectively."

Messrs. Wilson, Bristows and Carpmael are still unsecured creditors of the company for £1,326 4s. 3d., and have agreed under this contract to accept 66 of such preference shares of £10 each in full satisfaction and discharge of such debt.

Consolidated Telephone Construction and Maintenance Company. — This company has notified the Registrar of Joint Stock Companies that by a resolution of the company, passed on the 30th ult., the capital has been increased by the addition thereto of £75.000 in £1 shares, beyond the registered capital of £232,545.

Welsbach and Williams, Limited.—The annual return of this company, made up to the 18th inst., was filed on the 21st inst. The nominal capital is £34,000 in £1 shares, 14,000 shares are taken up, 9,000 being considered as fully paid. The remaining 5,000 shares have been paid up in full.

River Plate Electricity Company, Limited.—The statutory return of this company, made up to the 20th June, was filed on the following day. The nominal capital is £500,000, divided into 49,900 ordinary shares of £10 each, and 1,000 founders' shares of £1 each. The shares taken up are 10,007 ordinary, upon each of which £3 10s. has been called up, and 800 founders' shares, upon which the full amount has been called. The calls paid amount to £10,807, and unpaid to £25,017 10s., being £2 10s. per share on 10,007 ordinary shares. Registered office, 78, Coleman Street.

An agreement of 14th February (registered 18th April) between Walter Ritchie Cassels, on behalf of himself and of the firm of W. R. Cassels and Brother, of La Plata, and this company, provides for the purchase by the company of electric lighting enterprises and business carried on in the Argentine Republic by the said firm. The purchase consideration is £26,000 in cash and £24,000 in fully paid shares. Mr. Walter Ritchie Cassels is appointed managing director in South America at a salary of £700 per annum, and Mr. Francis Cassels is appointed superintendent in South America at a salary of £600 per annum ; in addition, these gentlemen will be entitled jointly to a commission of 3 per cent. per annum upon the net profits. Both appointments are for a period of three years.

West Middlesex Electric Lighting Company, Limited.—The annual return of this company, made up to the 19th December, 1888, was filed on the 22nd inst. The nominal capital is £100,000 in £5 shares. 524 shares have been issued, 400 of these being considered fully paid. Upon 124 shares the full amount has been called. The calls paid amount to £355, leaving £265 unpaid on 53 shares.

CITY NOTES, REPORTS, MEETINGS, &c.

The Manchester Edison-Swan Company, Limited.

THE seventh annual report of the directors of the Manchester Edison-Swan Company, Limited, states that the net profit (including last year's balance) for the year ending May 31st, 1889, amounts to £2,764 11s. 7d., which it is proposed to appropriate as follows :—

To payment of dividend at 5 per cent. per annum	£1,000	0	0
To reserve fund	1,000	0	0
Balance	764	11	7
	£2,764	11	7

During the past year there has been a considerable increase in the business done by the company, not only in the United Kingdom but also abroad. The satisfactory working of the numerous electric lighting plants installed, and the growing demand for both "arc" and incandescent lighting, afford great encouragement for the future.

The negotiations with the Manchester Corporation for the establishment of a central station in the City have been continued, but as yet without any definite result. The company have given the Corporation formal notice of their intention to apply to the Board of Trade for a Provisional Order, and in the meantime have asked their assent to an application for a licence.

Hitherto the directors have refrained from asking any remuneration for their services, but they consider the time has now arrived when this matter may properly be dealt with.

In accordance with the company's articles of association the Chairman (Mr. Vernon Kirk Armitage) retires from the board. He is, however, eligible, and offers himself for re-election.

At the ordinary general meeting held in the Memorial Hall, Albert Square, Manchester, on Tuesday last, the 25th inst., Mr. V. K. Armitage, chairman of the board, presiding, the report and the balance sheet were taken as read.

The Chairman, in moving the adoption, said the shareholders had reason to be well satisfied, and to congratulate themselves upon the result of the balance sheet. He attributed a very large share of the prosperity to the excellent work of their managing director, Mr. J. B. Williamson, whose services the directors were glad to acknowledge. Comparing the balance sheet with that of last year it showed an improvement. Last year they had only some £1,700 of profit. This year they had £2,700. During the current month of June they had received orders to the amount of nearly £5,000, and the installations on rental and in progress were represented by £3,910 as against £1,297. At an extraordinary meeting held some time ago the directors told the shareholders that the Manchester Corporation seemed rather to be holding their hands and waiting, as they put it, for more evidence of the wish of the public for the establishment of electric lighting stations in Manchester. In accordance with a resolution passed at that meeting, the directors issued throughout the centre of Manchester circulars, enclosing postcards, asking the recipients to say upon the cards whether they would be willing to take the electric light in case it was installed. The directors then only contemplated the establishment of a central station for 10,000 lamps, but in the course of three or four weeks they received in reply to those circulars applications or promises to take something like 14,500 lights. With this fact they again approached the Manchester Corporation, but he confessed his disappointment that they had made no further advance. It was true the Corporation had appointed a committee to deal with the whole question ; but what that committee had done, or whether it had done anything, he was not in a position to say. July 1st was the date fixed for giving notice to the local authorities of the intention of undertakers to apply for powers from the Board of Trade. This company gave notice to the Corporation that it was their intention so to apply ; that application had already gone in and had been acknowledged by the Corporation, but they had only received from the Corporation the same formal notice as before, that a committee had been appointed, and would, some time after July 1st, take the company's application into consideration. The growing confidence in the company showed that there was a *bonâ fide* demand on the part of the public for this light.

Sir Joseph C. Lee seconded the motion, and it was carried unanimously.

The Chairman moved that out of the profits of the last year £1,000 be devoted to dividend, at the rate of 5 per cent., and that a like sum be paid to the reserve fund, leaving a balance of £764 to be carried forward.

Mr. Edward Cross seconded the motion.

Mr. C. Agnew moved that the £2,000 should be devoted as stated, and that the directors should receive £300 out of the balance as an acknowledgement of the services they had for the past years given without remuneration.

Mr. R. Wheeldon seconded this.

The Chairman withdrew his motion in favour of Mr. Agnew's, which was put and carried unanimously.

On the motion of Mr. Agnew, seconded by Mr. J. F. Fisher, the chairman was re-elected a director.

Major Flood Page, a director, resident in London, gave some details of the parent company's litigations. He further said that he had asked the Board of Trade the question, and had learned from them that a corporation, even if it had the gas, could not prevent an electric light company establishing a central station. There was no doubt that this company would be able to obtain a provisional order, and it was infinitely better that they should stand upon their rights than that they should be indebted to the most amiable corporation in the world.

On the motion of Mr. Cheetham, seconded by Mr. Redfern, Messrs. Jones, Crewdson, and Youatt were reappointed auditors, and the meeting closed with a vote of thanks to the chairman.

TRAFFIC RECEIPTS.

The Brazilian Submarine Telegraph Company, Limited. The traffic receipts for the week ended 14th June, 1889, amounted to £2,305; and for the week ended 21st June, 1889, amounted to £2,414.

The Western and Brazilian Telegraph Company, Limited. The traffic receipts for the week ending 14th June, 1889, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £2,069; and for the week ending 21st June, 1889, were £1,867.

THE COUNTY COUNCIL AND ELECTRIC LIGHTING.

ANOTHER LETTER FROM THE BOARD OF TRADE.

THE weekly meeting of the Council of the Administrative County of London was held at the Guildhall on Tuesday (Lord ROSEBERY in the chair), when Mr. Alderman A. H. HAGGIS, the chairman of the Highways Committee, brought up a report, which stated that that committee had had under consideration a further letter from the Board of Trade, dated 13th June, 1889, on the subject of electric lighting in London, to which reference was made by the chairman at the last meeting of the Council. The committee had directed this letter to be printed, and a copy to be sent to each member of the Council. The model Provisional Order referred to therein had been considered by the committee, with the assistance of the Council's officers and the Parliamentary agent, and as the committee deemed some amendments desirable, they had, under the authority given to them on the 18th instant, requested their chairman and Mr. Benn, one of the members of the committee, to confer with the Board of Trade with a view to the amendments being made in the order.

The following is a full copy of the letter referred to above:—

"Board of Trade (Railway Department),
"London, S.W., 13th June, 1889.

"ELECTRIC LIGHTING ACTS, 1882 AND 1888.

"Sir,—I am directed by the Board of Trade to acknowledge the receipt of your letter of the 5th inst., and to request that you will convey to the County Council the thanks of the Board of Trade for the valuable assistance they have given in the matter.

"The Board of Trade have considered the several suggestions made in your letter, and I am now to enclose a copy of a model order which they propose to follow in all cases of applications in the metropolis now before them.

"With reference to this order, and the representations contained in your letter, I am to make the following observations:—

"1. The order to the London Electric Supply Corporation will be granted only on the condition that they provide duplicate sets of generating machinery and a duplicate set of mains in order to secure a proper and continuous supply in case of a breakdown of machinery or other defaults. And regulations will be subsequently issued to guard against danger to the public from currents of high tension.

"2. Streets will be scheduled in the several orders for the compulsory laying of mains; and provision is made for supply on proper requisition and on equitable conditions within the rest of the area of supply. There will be one exception to this rule. In the parish of St. James, the Vestry have advised the Board of Trade that no streets should be scheduled; and, looking to the nature of the parish, the Board of Trade propose to defer to the opinion of the local authority in this respect.

"3. Provision is made for the revocation of the order, in case of default, in respect of the whole area, or, with the consent of the undertakers, in respect of a part of the area, and that the consumer shall be called upon to bear only the cost of so much of any service line as exceeds 60 feet from any distributing main.

"4. Provision is made for the removal within two years of all overhead wires erected by the companies, and for possible forfeiture of the order if they invade or continue to invade a district within which they have no statutory powers.

"5. The proposed clause 55 of the London Company's order has been struck out.

"6. The Board of Trade propose that the model order shall be closely followed in all orders, and, so far as possible, in all licences granted in the metropolis.

"7. Provision is made to extend the Metropolitan Subways Act, 1868, to electric lines where any subway has been constructed within the area of supply. But as regards future subways, and as regards the vesting in the County Council of the power to make subways in the London streets, the Board of Trade are of opinion that these are matters which cannot be dealt with by them in a Provisional Order. The same remark applies to giving a veto to the County Council on the opening of thoroughfares.

"8. And as regards the exemption of the Council and vestries and district boards from liability in respect of damage done to mains in carrying out works of repair, and in the use of steam rollers, the Board of Trade think that, if any change is made in the present legal position, it should be dealt with by Parliament in a measure of general application.

"9. In addition to the provisions for the protection of sewers contained in the Gas Works Clauses Act, which are incorporated with the Electric Lighting Act, provisions have been inserted in the model order for the protection of sewers from the operation of all works in their proximity.

"10. Provision is made for the revision of price at the end of seven years on conditions to be then fixed by the Board of Trade. The Board of Trade, in the absence of accurate information as to the facilities for and the cost of supply of energy, think that it would not be reasonable to fix now the scale to be made applicable seven years hence.

"11. Provision is made to prevent the acquisition without the consent of the Board of Trade by one company of the undertaking of another, and the association of one company with another supplying or intending to supply energy. But the Board of Trade do not think that they could properly propose to Parliament that Parliament should part with its own powers of dealing with any future proposal to extend the statutory area of supply of any company.

"12. The price to be charged to local authorities is to be made the subject of agreement.

"13. The minimum charge for supply is fixed at 13s. 4d. a quarter.

"14. The Board of Trade concur in the view that, as far as is consistent with the principal Acts, there should be one controlling authority; and, with this object, they have vested in the County Council the appointment of Inspectors to—(*a*) Inspect lines and works. (*b*) Test currents. (*c*) Certify meters as being of a pattern approved by the Board of Trade. (*d*) Take proceedings.

"15. The cost of providing adequate testing stations will devolve on the companies.

"16. But the Board of Trade do not consider that they could properly insert in a provisional order, or in a Bill confirming a provisional order, a clause or clauses limiting or determining the powers of purchase given by the general statute to local authorities. The Board of Trade admit the force of the arguments which may be used in favour of setting up one purchasing authority for London, but they are clearly of opinion that this can only be done by a general Act.

"In drafting the model order, it will be observed that the Board of Trade have given effect, in all cases where it was possible for them to do so, to the wishes of the County Council, whose desire to facilitate the working of the companies' undertakings under proper safeguard of the public interests they fully recognise.

"In apportioning the areas the Board of Trade have departed very slightly from the recommendations contained in Major Marindin's report. It has been the earnest object of the Board of Trade to give effect to the views of the various local authorities. But it has been found impossible in the apportionment to carry out in detail all the wishes of the local authorities severally concerned. The Board of Trade have had to regard the metropolis as a whole, and they are pleased to observe that the County Council support generally the recommendations as to area made by Major Marindin.

"In conclusion, I am to state that it is most desirable that the Provisional Orders should be confirmed by Parliament this year, and they propose to introduce the necessary Confirmation Bills at the earliest possible date after the reassembling of Parliament on the 17th inst.

"I am, Sir, your obedient servant,
"COURTENAY BOYLE.

"The Clerk to the London County Council."

LEGAL.

Fyfe v. the Pilsen-Joel Electric Light.—This case came before Mr. Justice Mathew without a jury on Thursday, the 20th June. It was a claim by the plaintiff for money expended by him as acting member of a committee of investigation, which was appointed last year to enquire into the state of the company, the defence being that such expenditure was unauthorised.

Mr. Kennedy, Q.C., and Mr. T. W. Chitty appeared for the plaintiff; Mr. Scrutton for the defendant.

The plaintiff stated the circumstances under which the committee of investigation, consisting of himself, Mr. Gwynne, Mr. Hopkins, and Mr. Hutton were appointed, and they were to report to an adjourned meeting in a month. The company had three installations in London in different places, and several miles of wires; the gross income was about £5,000 or £6,000 a year. The committee at the first meeting arranged the programme, to take stock, go through the books, have them written up, and generally ascertain the state of the company's affairs. It would have been utterly impossible for the committee, without employing technical assistance, to prepare their report within the time named. Mr. Elworthy was employed to take stock, and was paid £50. He gave particulars of the persons employed, and also the work they did. One gentleman he had paid £30, though he had only charged £15.

Mr. Hutton and Mr. Hopkins gave corroborative evidence, and correspondence was read. Mr. Hutton said he had not authorised the employment of a valuer and an accountant; he should, no doubt, have done so had he been asked, but he said, when appointed, that he could not give much time to the investigation.

Evidence was also given by some of the gentlemen who did the work in question.

On behalf of the defendants, Mr. Trentham, formerly secretary to the company and now one of the voluntary liquidators, was called to state that in February of the present year the stock had been taken, being practically the same as it was in March, 1888, and a charge of 25 guineas only made.

Mr. Gwynne said he was nominated one of the committee of investigation, but took no part in the proceedings. He was not aware the committee were incurring any expenses. In one of his letters to the plaintiff he referred to the necessity for the stock being valued by an electrician, but he thought the plaintiff would do it himself, or send one of his assistants to do so.

The further hearing was adjourned.

On the case being resumed on Friday, judgment was given for the plaintiff with costs.

THE RECENT THUNDERSTORMS.

A very important and at the same time interesting communication on the recent thunderstorms was made by Mr. William Marriott on Wednesday evening at a meeting of the Royal Meteorological Society held in the lecture room of the Institution of Civil Engineers.

Mr. Marriott, who is secretary of the first mentioned society, exhibited four wall diagrams showing the time of outbreak, the place of damage, and the direction taken by the thunderstorms which took place on the 2nd and 6th of June last. On the former date the storm travelled, or, as he termed it, was propagated at the rate of about fifty miles an hour, commencing in the south of England and proceeding in almost a straight line over an area in width of from forty to fifty miles to Edinburgh, and even further north. During the progress of this storm hailstones fell in Bolton from 2 to 3 inches in circumference, whilst at Chester some of the hailstones found measured from 4 to 5 inches in circumference, and weighed no less than 2½ oz. In Staffordshire one was found 3 inches long by 3½ inches broad. Mr. Marriott then gave particulars of the storm as it occurred in the eastern counties. Turning to the great storm of the 6th June, he stated that on that evening there appeared to be three distinct thunderstorms raging simultaneously in London and coming from different directions; but, so far as observations had gone, it could not be determined that they were distinct from one another. He had himself noticed flashes which apparently repeated themselves four or five times. Among the collection of about forty photographs of lightning which were exhibited, and which were taken during that storm, were several showing four distinct flashes. These photographs were taken while the camera was moved from one side to another, and if it had not been for that movement he considered that they would have been unable to determine whether or not there had been four simultaneous discharges.

Mr. Clayton showed some half a dozen photographs illustrating the combined light and dark flashes, and that gentleman had found in the south of London hailstones 1 inch long and ¾ inch thick, whilst in the north of London some heavy stones were also picked up.

Mr. Marriott had been asked how many flashes had occurred in a minute, and he had guessed twenty; but Mr. Wallis had in the north of London recorded 1,244 in two hours, or about 10½ per minute. In the storm at Margate, which commenced in the evening, it was considered that no less than 131 flashes took place in one minute, but beyond that figure it had been impossible to go, since the rapid succession of the flashes was so great. Mr. Young had found a hailstone weighing ½ lb., and it was reported that another which fell was ¾ lb. in weight. Mr. Marriott exhibited some very large hailstones which had been discovered some time ago, after which he drew attention to the photographs. These represented flashes of lightning in the sinuous, straight, ribbon, and other forms, also of the dark flashes. The speaker had not been able to form any definite opinion as to the reason of the formation of the dark flash, but they had fortunately been able to obtain photographs of it exhibiting two if not three new features. Mr. Clayton, who had been successful in obtaining photographs of these remarkable flashes, had held his camera in his hand and moved it backwards and forwards. It would have been interesting if two cameras had been used, one fixed and the other held in and moved by the hand. Had that been done they would have been able to determine whether the multiple and dark flashes were due to the movement of the camera or otherwise. Dr. Hoeffert had moved his camera very rapidly to and fro, and in that case three distinct flashes were found on the photo which was exhibited. With regard to the duration of the flashes, he had come to the conclusion that the theory that the persistency of the flash lasted only about one millionth of a minute was a fallacy, as in the recent storms several flashes were visible for some time, the duration of one having been recorded as two seconds.

An animated and interesting discussion then ensued. One speaker rather humorously remarked that after the discovery of hailstones weighing from ½ to ¾ lbs. it would be advisable to give credence in future to accounts of storms emanating from America and other countries. The next gentleman who addressed the meeting made an important suggestion to the effect that henceforth it would be politic to have the sensitive paper in the camera in the form of a roll so that the form of the lightning could be taken in sequence.

Dr. Hoeffert then described how he had taken his photographs. Several other speakers followed, and the unanimous opinion formed regarding the duration of a flash of lightning was that the old theory must be considered as exploded, and that flashes may continue for a few seconds. No definite decision, however, could be arrived at as to the cause of the dark flashes observed in the atmosphere and shown in the photographs. There is, however, one form of lightning to which no allusion was made, namely, that of apparently red lightning in the form of a ball of fire running horizontally through the atmosphere. It would have been interesting had some light been thrown upon this matter.

THE ELECTRIC LIGHT IN GLASGOW.

The Glasgow Town Council, at a meeting held on Tuesday, had under discussion a recommendation of the gas committee to the effect that the corporation should give notice of their intention to apply for a provisional order authorising them to supply electricity for light and power purposes.

Mr. William Ure, in submitting the recommendation, said the application would be simply for their own protection, and ample time would be given for consideration.

Mr. M'Laren, who seconded the motion, said it was necessary the council should take steps to maintain their position in this matter. For some years very little had been done in regard to electric lighting, but during the past year various corporations and companies had taken active measures in connection with the light. Several large cities in England were in a similar position to Glasgow in the matter. They had allowed private companies to be started without having Parliamentary powers, and they had now come forward and applied for provisional orders. In Bradford a very strict inquiry had been made, and it had been agreed to apply for a provisional order to supply electric light to their own city, and they proposed to expend a sum of £30,000. In Bedford they had also resolved to apply for powers to supply electric light to the city. At Leeds it had been agreed to put down plant to the value of £60,000; while in Birmingham, which was in the same position as Glasgow as regarded its gas supply, the corporation proposed not to provide electric light themselves, but rather to support a company for that purpose. Recent enquiries had, however, shown that the best system was for the Corporation to take up the matter. He therefore hoped the Council would agree to give the notice recommended in the minute.

Mr. Martin wished to know whether it was the intention of those moving in the matter to go on with this undertaking in the event of their getting powers, or was this simply a method of blocking the way to other parties?

Mr. Ure replied that they could not possibly get the Provisional Order without giving a guarantee that they would carry out the undertaking. Of course, it would depend upon the conditions which were applied to them whether they thought it desirable or practicable to agree to them. On the last occasion when they applied for a Provisional Order one of the conditions imposed by the Board of Trade, if they got the Order, was that they would be bound to supply every one with the light who applied for it, although they might have to carry it to places half a mile apart. This was a condition which they could not possibly agree to, and they did not agree to it, but withdrew their application on that account. He hoped that with the experience gained in the interval the Board of Trade would remove some of the conditions which the Council formerly could not agree to.

The recommendation was adopted.

ELECTRICAL TRADES SECTION OF THE CHAMBER OF COMMERCE.

Important Report and Discussion.

On Monday last a meeting of the Electrical Trades Section of the London Chamber of Commerce was held at Botolph House, Eastcheap, under the presidency of Mr. Crompton, for the reception, *inter alia*, of the report of the committee. Among the members present were Major-General Webber, Major Flood Page, Mr. Callender, Mr. Wallace, and Mr. Garcke.

After the discussion of some unimportant business, Mr. Trotter, the secretary, submitted the following report:—

"Electricity Supply Sub-Section, at a meeting on the 27th November, considered the Board of Trade regulations and accounts, and recommended the committee that the Board of Trade should be requested not to issue any general regulations applicable to all undertakings until the supply companies had had, say, a couple of years' experience of working.

"Electric Measuring Standards.—At a meeting of the committee on the 7th January the question of electric measuring standards was considered, and it was decided to request the Institution of Electrical Engineers to consult with a committee of the section on the subject. On March 28th a communication was read, stating that the Institute would be prepared to meet a committee, and thereupon it was appointed. On the next day it was received by the Institute, and on the 20th of June a deputation from the two bodies waited upon the President of the Board of Trade.

"At the meeting on the 28th of March the question of a reliable standard for photometrical work was discussed, and it was decided to urge upon the Board of Trade the desirability of a change in the existing standard of light as defined by the Act of Parliament.

"Overhead Wires.—On the 4th February the question of overhead wires was considered, and a committee appointed to go into the matter. A special meeting was held at the Westminster Town Hall on the 6th April to receive a communication from the President of the Board of Trade, in which he stated that he would receive a deputation on the subject, but as the committee had not seen a copy of the rules it was decided to ask the President to defer the deputation until they had been able to consider the rules. At a meeting of the committee on the 3rd June the draft rules were presented, and referred to a sub-committee.

"Standard Types of Apparatus.—This question came before the committee on the 4th February, and referred for consideration to a sub-committee.

"Standard Specifications.—At the same meeting this matter was discussed, and also referred to a sub-committee.

"Arbitration.—Mr. Price presented his report on this question, and, with certain modifications and additions, it was decided to adopt the Chamber's rules.

"Railway Rates.—At a meeting of the section on the 28th March this matter was considered, and referred to a small sub-committee. The report of this sub-committee was presented to the committee on the 13th May, when it was decided to request the Chamber to lodge it with the Board of Trade and railway companies, which was accordingly done on the 3rd June.

"Technical Correspondent.—At the same meeting it was suggested that the Section should appoint a gentleman to act as technical correspondent, and it was decided to recommend the Council to allow such appointment. At the committee meeting on the 6th April it was stated that the Chamber were willing to adopt the Section's request, and, accordingly, Mr. Trotter was appointed to the post.

"Bradford Rules.—At the meeting of the committee on the 3rd June Mr. Shoolbred submitted to the meeting the Bradford rules, which were discussed at some length."

The Chairman then said that the electrical trade section of the Chamber had been in existence since October 22nd last, when the working committee was appointed. The first sub-section which met was the electricity supply section. That was at a meeting in November, and they had since done a considerable amount of work. Among the various recommendations made at the several meetings was that the committee should take steps to secure that the Board of Trade unit should be increased tenfold, from 1,000 to 10,000 watt hours. That was noticed in the Provisional Orders, but for some reason or other the Board of Trade did not see fit to carry out the recommendation, and they adopted the views of the committee of the electrical engineers, and seemed to think there was no sufficient reason for the suggested change. However, he thought the committee, as a body of commercial men, were the better judges of the question. Still, it was not a matter of the very greatest importance. But it would certainly have been an improvement, and strong arguments in its favour were put forward by Lord Crawford. Notwithstanding, the fact remained that they had not been able to carry their recommendation. The next matter before the committee was a recommendation to the effect that there should be united action on the part of undertakers declining to pay the legal expenses of local authorities when it was proposed to do so. That was a very good recommendation, and he hoped that it had had some good effect. Although, of course, they could not bind persons in that respect, there had been a general refusal on the part of undertakers to pay the heavy bills which had been sent in by some of the local authorities. Another recommendation of the committee was to urge all electrical supply companies to stand firm upon the question and decline to sell their undertakings in a shorter period than 42 years. He believed that that point was brought forward because there was a suspicion that two or three of the supply companies were going behind the backs of others and offering to agree to the old period of 21 years. And the result of the passing of the committee's recommendation was to have the very good effect of nearly putting an end to the steps taken by those few companies. Then the next recommendation was that the supply companies should require two years as the minimum period for which compulsory works should stand. He did not know what had been the effect of that recommendation. Perhaps Mr. Wallace could inform them.

Mr. Wallace: I believe it is two years in the order.

The Chairman continued, that the electrical supply sub-section at another meeting considered the Board of Trade regulations in regard to accounts, and recommended the committee that the Board of Trade should be requested not to issue any general regulations to be applicable to all the undertakings until the electrical supply companies had been at work for a period of about two years. He was not aware that the Board of Trade had pressed for the accounts, and he believed that they had acted upon the hint of the committee. The next committee that got to work was the electric measuring standard committee. At the beginning of the year they met and considered the question of a measuring standard, and it was decided to confer with the Institution of Electrical Engineers to consult with them on the subject. There was some delay not, however, due to the Chamber. But when the two committees got to work it was decided that there should be a deputation of the two bodies to wait upon the President of the Board of Trade. And in furtherance of that an estimate was prepared by the Electrical Engineers' committee as to the least sum which would be required for establishing a laboratory. And with that information in their hands a deputation did attend and wait upon the Board of Trade.* They met with a favourable reception, and he believed that there was every reason to think that there would be a standardising laboratory. If that was achieved it would be one of the results of the electrical trade section. There had been an agitation on that subject for several years, but no great results had followed; and it was to the joint action since the commencement of the year that the measuring standard would be obtained, if it were obtained. The next point was that on the meeting of the 28th of March the question was discussed of a reliable standard for photometrical work, and it was decided to urge upon the Board of Trade that it was most desirable that there should be a change in the existing standard of light as defined in the Act of Parliament. That meeting went to the Council, and it was resolved that a letter should be written to the Board of Trade to the effect that the old candle was a very unreliable standard, and that Mr. Vernon Harcourt's standard should be adopted. The letter was acknowledged, but he did not know what had been the result. Upon the 4th of February the question of overhead wires came up, and a committee was appointed to consider the subject. A meeting was held in April at the Westminster Town Hall, for the purpose of receiving a communication from the President of the Board of Trade, who wrote that he would receive a deputation. But a copy of the rules had not then been obtained, and the electric lighting enquiry was sitting at the time. The meeting was postponed for a time in order that they might consider the rules. After some difficulty they had been able to obtain a copy of the rules which had been criticised by the committee, and various modifications suggested within the last few days. The rules were very good ones, so far as overhead wires in London were concerned, but they had the tendency to make overhead wires very expensive for rural districts, where such extreme safeguards for the public against falling wires were not so necessary as in crowded towns. The question was still under consideration by the committee, and, as a matter of fact, the position of affairs was that the Board of Trade rules were still on the table of the Post Office solicitor. One advantage of the delay was that they had found out a mistake as to the volts, and that had been corrected, and now there was to be 300 volts between the conductor and the earth, or between the conductors or any one post. The next subject was that of the standard types of apparatus, but no great progress had been made as to that, as it was difficult to get agreement on the subject, as no one seemed inclined to have a standard. The only thing in which there seemed to be a cordial agreement was that it was desirable to have a small screw thread standard. The screw thread committee sat some time ago, and were at great pains to devise a thread which would meet all the requirements. With the exception of the Post Office and their instruments, no standard had been generally adopted. He had received a number of letters on the subject, and it appeared to him to be a very proper subject for the Chamber to take up. They might be able to make some arrangements by which it should be more generally known where the screw plates could be obtained, and where sample screws might be exhibited. That would probably be for the benefit of the trade. It was one of those things as to which the organisation of their section might be usefully employed, as it seemed to be one of those subjects in which no contentious matter was introduced. Otherwise, the question of the standard type of apparatus had not got on very well, because there had been great difficulty in obtaining any information. The subject of standard specifications, also, had not got on very well, but the sub-committee had it under their consideration. Although they had reported, nothing practical had been decided upon as yet. The question of arbitration had been discussed, and a committee appointed. A report by Mr. Price was presented, and certain modifications proposed and agreed to, and the rules of the Chamber were adopted. He had carried the matter to the Council, and they agreed to adopt the modifications suggested. It was thought that as arbitrations on electrical matters were very complicated, and required technical knowledge, they could not dispense with professional aid; and, whilst adopting the ordinary rules of the Chamber as to arbitration, it was decided to add to them the power of employing counsel in cases where it was thought desirable. Upon the 28th of March the question of railway rates was considered and referred to a small sub-committee, who went to work energetically, and a very excellent report was drawn up, for which they were very much indebted to Mr. Garcke. That was lodged with the Board of Trade on the 3rd of June. The committee had not finished their labours, as there were other matters which would have to be brought before them later on, and he believed it would be found that their work would be of the greatest benefit to the trade. At a meeting held during the Board of Trade enquiry into the question of electric lighting, it was suggested that the section should have accurate information of what was going on, and it was resolved to appoint a correspondent to give his whole time to the matter. Mr. Trotter was requested to undertake the responsible work, and consenting to do so, he was appointed, and the result of his labours had been to very greatly strengthen the section. There was then the small matter of the Bradford rules as to the supply of electricity. Mr. Shoolbred had pointed out that certain rules were being issued by the Bradford Corporation which might be generally followed. A copy of the rules had been obtained and discussed, and might prove to be of some use. In conclusion, the chairman said he hoped the meeting would not consider that the section had been idle, for, although there was not very much to show, what had been submitted was practically the result of only six months' working.

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* See the Review for last week.

Major **Flood Page** ventured to differ from the chairman, and thought that there was a very good show indeed, considering the short time the section had been at work. It was the most active section of the Chamber, and although the youngest, it was not the least important. One great object they had was publicity, so far as the electrical trade was concerned. Therefore he proposed that a copy of the report be sent to the electrical and engineering papers. It would show that they were fairly active. He would therefore move a resolution to that effect.

Mr. **Garcke** had great pleasure in seconding the motion. He said that since the section was formed, large additions had taken place in the electrical industry. It was very desirable that the section should be thoroughly representative in its character. As many persons concerned in the business were not members, it would be well that the kind of work done by this section of the Chamber should be brought prominently before their notice, in order to secure their adhesion to the section.

The **Chairman** stated that the committee on the standard type of apparatus had prepared a draft of questions connected with the screw thread in order to send it out to the trade, as it would be very useful and interesting to get the views of the trade upon that subject. The questions showed that the committee had expended a great deal of labour on the matter.

The resolution of Major Flood Page having been supported, was agreed to unanimously.

Mr. **Trotter** (the secretary) said that although Major Cardew did not hold out any hopes of yielding on the subject of overhead wires, some important matters would be submitted to the Board of Trade by the committee especially considering that matter. The rules of the Board of Trade as to overhead wires were not, however, quite so stringent as was at first thought. The Post Office had a lightning conductor on every post equal to 7/16's iron wire. The committee found that the rules as to the overhead wires were drawn up in accordance with the Post Office rules. But there were one or two important points worthy of consideration. He had been told that the whole of the overhead wire question had been given over to the London County Council. He did not know how true that might be, but he heard that the Council had said already that they would sweep them all away.

Mr. **Garcke** enquired as to what was to be done with regard to overhead wires in the provinces.

Mr. **Trotter** replied that the rules were to be modified for different districts. There was to be more latitude allowed for the rural sanitary districts. The overhead wire committee proposed to draw up some amendments for submission to the Board of Trade, and would endeavour to obtain an interview with the President on the subject.

Major **Flood Page** thought that in regard to the question about the London County Council's powers, it was quite as well to to realise the fact that there were many strong indications at the Board of Trade that the electrical lighting, and the use of electricity generally, was extremely likely to be handed over to the new County Councils. One matter had forced itself upon him as of very vital importance. He had to go to Manchester the next day, and there was a company there—the Manchester Edison and Swan Company—which had given notice for a Provisional Order. He had taken the opportunity of pointing out to the Board of Trade the extraordinary position in which they would be placed if they were handed over bodily to the Manchester County Council, which was coterminous with the Manchester Corporation, who were the gas owners, and who had placed every difficulty in the way of electric lighting in Manchester. If they were to be the sole judges, and if the electric lighting companies had to go to them, and the Board of Trade were to do nothing, there must be an appeal to the Board of Trade, where the County Councils and the local authorities were opponents to the electric lighting. And he thought that such opposition would arise in many places. The meeting were doubtless aware that Sheffield and several other Corporations had had Provisional Orders from the commencement, and yet none of them had done anything up to the present. There was the practical question which would come up before them, and that was what ought they to do in view of the probability that the electric lighting industry would be handed over to the County Councils throughout the country. In London they might get some kind of protection, for the Council had not got the gas in their hands; but in the provinces, where they had the gas under their control, the matter might become a very serious one.

Mr. **Callender**: I see that in Glasgow they have given notice to apply for Provisional Orders upon a definite statement that it will preclude others.

Major **Flood Page**: It is useless to deny that the Board of Trade contemplate shifting the whole thing off their hands, and there should be, as in the case of Manchester, a power of appeal to the Board of Trade. As Mr. Callender says, Glasgow is going in for the express purpose of preventing the electric light.

The **Chairman**: Is it not the best plan to watch all these things? The proper function of this body is to memorialise the Board of Trade in all these cases.

A **Member**: We should have a separate memorial in each case.

The **Chairman**: Yes, in each case. There might, the chairman thought, be some means of obtaining information of what the other Chambers were doing in this matter.

Mr. **Kenric Murray** stated that they could communicate with other bodies affiliated with the Chamber and obtain information especially in regard to Manchester.

Major **Flood Page** pointed out that the gas influence was very strong in Manchester, as he knew from painful experience in dealing with them. It was very important that there should be some power of appeal to the Board of Trade if the electric companies were to be handed over bodily to the County Councils.

Mr. **Murray** said he could confirm the opinion as to the tendency of the Board of Trade to diminish their responsibility of action because the Chamber had experienced it in several ways.

Major-General **Webber** was afraid that the model order might bring about a state of things which would cause it to be too late for the section to move; for he presumed that if the order became an Act of Parliament this session it would then be too late to take action. The present was the time for the committee to act. There were two very important points in the model order which should be considered. One was the absolute control or veto of the County Council against all overhead wires, and the other was in regard to testing. It was well that it should be known that the power of the electrical inspector to enter in and test the electric lights of any company was absolutely at his own option, and the company was bound to pay him any fees the Board of Trade had sanctioned for such visits. That was an arbitrary condition to which no electric lighting company should submit. It was bad enough to have an electrical inspector when he was ordered by a local authority to come in and test the company's main, and then be called upon to pay him; but that he should be allowed to do it at his own sweet will and pleasure, and be paid for it, was very hard. If they were to get that clause in the model order altered they ought to set about it at once.

The **Chairman** thought that it would be very difficult to do as suggested. Those, among other things in the model order, had been considered during the past week. Under the Metropolitan Building Act the Metropolitan Board of Works had a dispensing power. But the London County Council had come to the conclusion suddenly that it was too great a responsibility for them, and they would not do it. An endeavour was made to put it in the provisional orders that the Council should have the power of dispensing with such small matters as partition walls, but they absolutely refused to agree to it.

Major-General **Webber** remarked that in the case of the inspectors the Council would deal with it. It was a case in which some revenue would accrue to the Council, and the more inspectors the more they would receive.

Major **Flood Page**: Where are all these inspectors to come from? Is it necessary for them to have any knowledge of electric lighting? (Laughter.)

Major-General **Webber**: Although it is said to be too late, I venture to suggest that it is quite within the power of this section to oppose this Bill in Parliament.

The **Chairman**: That is very practical.

Mr. **Murray**: There is nothing to prevent that.

Major-General **Webber**, after reading the clause as to the inspectors, said that the only saving clause was in the event of the undertaker being able to prove that the customer was at fault. It was a very hard clause indeed, and one which no gas company would submit to.

Major **Flood Page** was of opinion that if they got up anything like an active opposition to the Bill they would not get any orders through this Session.

The **Chairman**: Yes; this is a question of policy.

Major **F. Page** believed there were a good many indications that efforts were to be made to adjourn the Session as soon as possible; and perhaps, therefore, if there was anything like an active and successful opposition got up, they might in their endeavours to get rid of some bad clause lose the whole thing.

The **Chairman** suggested that the proper course would be to refer the whole matter to committee.

Major-General **Webber**: Is that any reason for submitting to an irksome rule which will be in force for all time?

The **Chairman**: No, not for all time.

Mr. **Garcke** urged that the suggestion as to opposing the Bill should be agreed to in view of the enormous difficulty of getting the model order adopted. He quite saw the advisability of not doing anything to prevent the orders going through this year or of doing anything which would delay legislation, but at the same time they knew from experience how difficult it was to get anything of that kind in a model order modified. It was a matter about which they ought to be very careful before coming to a decision as to taking any steps to get it amended.

Major-General **Webber** stated that having read the model orders over very carefully, that seemed to be the only clause to which they need strongly object.

Upon the suggestion of the Chairman, the whole question of the provisional orders was referred to the supply sub-committee to consider. The meeting then separated.

THE SPIRAL COIL VOLTAMETER.*

By HARRIS J. RYAN.

DURING the present year at the Physical Laboratory of Cornell University, the copper voltameter has been used somewhat extensively in laboratory practice by students for calibrating Thomson graded galvanometers, tangent galvanometers, and other electrical measuring instruments where a single determination suffices as a calibration. For practical instruction students are made to check their results on a Thomson gravity balance, and by means of the large galvanometer at the Magnetic Observatory.

The plate form of copper voltameter has been thoroughly and admirably investigated by Mr. Thomas Gray,† of the Physical Laboratory of the University of Glasgow. We are indebted to Mr. A. W. Meikle‡ and to Lieutenant Anderson§ for clear descriptions, based upon the results of Mr. Gray, for the use of this form of voltameter, whereby determinations may be made so accordant that one can scarcely think of more to be desired.

With all this, however, it has been our experience that students are slow to obtain accordant results when making their first attempts to follow Mr. Gray's methods. It seemed desirable to make use of a form of voltameter that required the least consistent time and care to construct and prepare for operation. Again, there should be a wide allowable range of current density, through which deposits would be as firm and adherent as possible. It was with a view of realising this that we finally adopted and made use of the spiral coil form herein described.

A wire coil as a cathode seemed to present many advantages. Wire of high conductivity, good for this purpose, is generally available in any desired size. A wire can be cleaned properly with great ease and readiness by fastening one end in a vice, holding the free part in one hand and sandpapering it with the other. By beginning at the vice to clean it is not necessary to touch the cleaned wire with the hands throughout the complete operation of polishing and coiling into a spiral on a cylinder of the proper diameter, about which has been rolled clean paper. In this manner gain and loss coils are constructed.

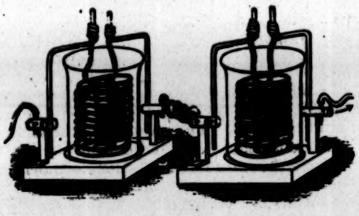

FIG. 1.

Figs. 1 and 2 show the final form of voltameter adopted. The coils are hung vertical. The cathode is made of a smaller diameter and is arranged inside and concentric with the anode. The diameter of the anode is made about 3 cm. to 4 cm. larger than that of the cathode. The loss coils prepared as above are ready for use, since for well-known reasons their changes of weight are never accordant. The surface of the gain coil must not be touched by the hand. It is easy to handle it by the extending terminal, by means of which it is suspended in the voltameter. After polishing it is washed by plunging into a jar of water containing a little H_2SO_4.

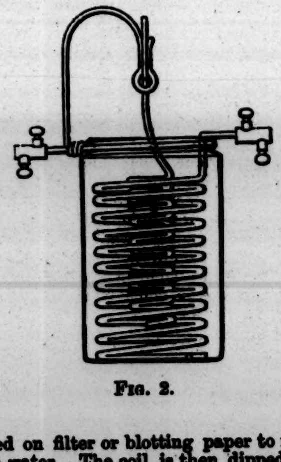

FIG. 2.

It is then rolled on filter or blotting paper to remove all but a mere film of the water. The coil is then dipped in 95 per cent. alcohol, removed and the excess of alcohol allowed to drip into the jar of the same. By rolling the coil on clean filter or blotting paper again, nothing but a mere film of alcohol remains, and that is thoroughly evaporated in a few moments, leaving the coil entirely dry.

Coils that have been laid away and become corroded can be readily cleaned, as is well known and directed, by plunging them into a mixture of strong HNO_3 and HCl, 100 parts of the former to one of the latter, removing them quickly to a distance, such that the vapours of the acid shall not reach the coil during the rest of the preparation. This consists in washing first thoroughly in water, and then proceeding as at first described by plunging in the acidulated water, alcohol, &c. After weighing, the coils are ready for the voltameter.

It has been customary with us to use a coil made of two and one-half metres of No. 16 wire, having the surface area of 100 square centimetres.

For great strengths of current a number of these are arranged in parallel.

For every four ampères one wire is necessary. At the end of the deposit the gain coils are immediately removed, and plunged first into clean water and then into the acidulated, from which they are dried by means of alcohol in the manner above described. When dried they are at once ready to weigh.

The copper sulphate, water and acid, need not necessarily be chemically pure. The density of the voltameter solution should be not less than 1·10 and not more than 1·18.

The question now comes to us as to what degree of accuracy and precision of results we may depend upon from the above form of voltameter.

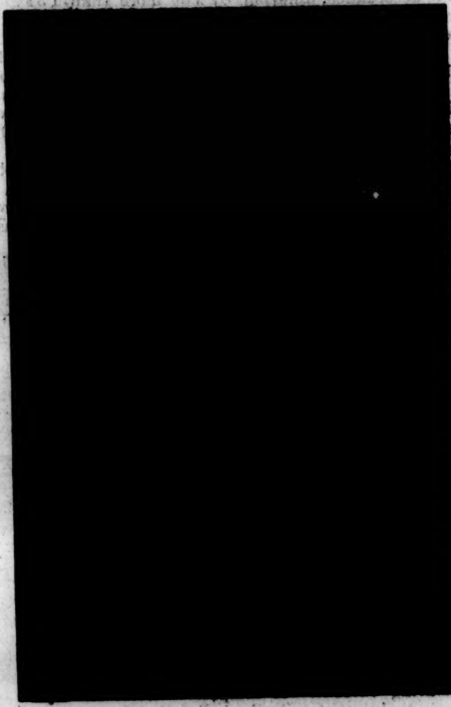

FIG. 3.

The successful use of the copper voltameter has come from an appreciation and an understanding of the fact that when copper is immersed in an acidulated solution it passes slowly into solution in an irregular way. Mr. Gray has done much work in this particular, and has shown that the going into solution of copper on the cathode is curiously assisted by the current. From the extensive work done with the plate form of voltameter at Glasgow results have been gained with regard to the amount of copper that goes into solution for a certain current density and a certain temperature, that it is a comparatively easy thing to make determinations with assured absolute accuracy to within a tenth or even a twentieth of 1 per cent. This is remarkable, though nevertheless true.

A Thomson deca-ampère balance was calibrated by means of the copper voltameter under Mr. Gray's directions at Glasgow.

When the same was received and set up at Ithaca in the physical laboratory of the University, it was compared with the large standard tangent galvanometer at the Magnetic Observatory, and found to agree with the same to within one-tenth per cent.

Surely this same or even a greater degree of absolute accuracy could be obtained with less trouble and experience by one making use of the spiral coil cathodes. Mr. Gray has shown that if copper went into solution, unaided by the current, that we could in almost all cases neglect this correction. He has shown us how much it is when a plate is used as a cathode. There are strong reasons, however, for believing that when a wire which presents a regularly curved surface is used as a cathode that the copper from it goes into solution in a more regular way, and that probably in all cases to a considerably less degree. Again, by the use of the spiral coil in a voltameter we find an advantage in the fact that the plane of each turn of wire is disposed horizontally, so that by convection the solution is not allowed to become weak near the cathode, nor dense near the anode.

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* A paper read before the American Institute of Electrical Engineers, New York, May 22nd, 1888.

† *Phil. Mag.*, 1886 and 1889.

‡ *Lond. Elec. and Elec. Review*.

§ *N.Y. Electrician*, October, 1888.

This fact was first pointed out by Mr. Shaw, who speaks of the very accordant manner in which platinum wires disposed horizontally are found to act as cathodes in copper electrolysis.

In a valuable paper by Mr. Shaw* on "The Verification of Faraday's Law of Electrolysis with Reference to Silver and Copper," the very great range of current densities for the deposition of copper on platinum wires of 8 centimetres to 800 centimetres per ampère has been brought to bear on the ratio of silver and copper deposits when the currents are the same. From data taken from this paper, the writer has plotted curves that show the relation of current density to copper deposit throughout Mr. Shaw's work at the Cavendish Laboratory and Emmanuel College.

The work extended over a year, and was done with much care. These curves are shown in fig. 3. The ordinates represent the amount of silver deposited by the same current that deposits unit weight of copper in a given time, corresponding to current densities, as represented in square centimetres per ampère on the abscissæ axis. As is seen, with the exception of two, the curves are in remarkable accordance, differing by not more than 1·34 per cent. With regard to the two curves that fall above and below the rest, we would say that their position can easily be attributed to accidental causes; the error in the indications of the silver voltameter of a 1·5 of 1 per cent. either way would account for their position. Again, Mr. Shaw used no acid in the voltameter solution, a fact that will account for irregularities. Of these lines the heavy one was drawn as a fair average of them all. A glance at this line will derive some interesting results:

We see that with a current density of 50 square centimetres per ampère the ratio of silver to copper deposited is 3·401. In the early part of Mr. Shaw's work, in a long series of observations, this same identical ratio as a mean for a mean current density the same as above was found.

Mr. Gray, when at work on the same ratio, determined the same identical value.

Finally, the writer has found that if we take the values for the chemical equivalents for silver and copper as quoted by Wurtz and those given by Meyer, that the calculated values for this ratio are 3·401 and 3·399 to 3·401.

Therefore, since we know with great assurance the value of the electro-chemical equivalent of silver, we have an equal assurance that with a *current density of one ampère* for *every* 50 *square centimetres exposed* the *amount of copper deposited* will be ·0003287 *grammes* per *coulomb*.

Again we see that in a range of current density from 50 centimetres to 300 centimetres per ampère this line indicates a change in the amount of copper deposited from ·0003287 to ·0003270. It is to be remembered that these results were obtained by the use of a solution almost saturated and without acid. Returning to Mr. Gray's work, we find that for the same range of current density the amount of copper deposit changes from ·0003287 to ·0003272 for a temperature at which Mr. Shaw probably worked.

It is well known that the copper goes into solution under the action of the current from the cathode at much a greater rate without acid than with, and especially at a greater rate when the solution is dense than when working under the proper conditions for measuring current. A comparison of Mr. Gray's and Mr. Shaw's results brought us to the belief that less copper should be dissolved from cathodes of the spiral coil form than those of the plate form.

To determine this, four cells were arranged by Mr. Gunning, a student in the Sciences at Cornell. Two of these had cathodes and anodes of the plate form, and the other two those of the "spiral coil" form. The large plate and coil, and the small plate and coil had areas of 100 centimetres and 10 centimetres respectively. About half an ampère was passed through them for a time, amounting to two and one-half hours.

Every half hour they were taken out, dried and weighed, the solutions all intermixed, and the deposits continued for another half hour, &c.

The solution had a density of 1·1, and an addition of ½ per cent. acid. An examination of the intermediate results gives the same result that one gets by looking at the total gain of the coils and plates taken separately. Mr. Gunning's results were as follows:

Temperature, 20 *degrees*.

Coils.		Plates.	
Small.	Large.	Small.	Large.
10 c.m.	100 c.m.	10 c.m.	100 c.m.
1·8220	1·8182	1·8196	1·8188

The results show that in going from a density of 20 centimetres to 200 centimetres per ampère, the amount of copper per coulomb changed from ·0003289 to ·0003283 for the coils, and for the plates, ·0003285 to ·0003275.

The result with the plates does not differ materially from that found by Mr. Gray for a similar range.

Mr. Gunning also made a number of comparisons of the spiral coil voltameter at different current densities, and at a mean temperature of 23 degrees centigrade, with the standard tangent galvanometer at the Magnetic Observatory. They were made with great care in every particular but one, and that was in the matter of time. This was taken from his own watch, that had not been compared with our standard chronometer. Again, to make and break the circuit, a large switch capable of carrying 250 ampères was operated, which added incidental errors, since the duration of each deposit was only 1,800 seconds; the results are interesting, because of their accordance and the manner in which they were obtained, and are given in the following table:—

Date.	Size.	Current	Gain in grammes.		Grammes per ampère per hour.
			Coil No. 1.	Coil No. 2.	
May 8 and 9.	110 cm.	·6788	·3985	·3977	1·176
„ „	„ „	1·312	·7699	·7704	1·177
„ „	„ „	1·882	1·1060	1·1055	1·178
„ „	„ „	2·446	1·4364	1·4672	1·178
„ 6 and 7.	116 „	3·008	1·7686	1·7676	1·179
„ „	„ „	3·532	2·0755	2·0753	1·179
„ „	„ „	4·016	2·3639	2·3639	1·180
„ „	„ „	4·495	2·6386	2·6326	1·176
„ „	„ „	4·930	2·8962	2·8910	1·176
„ „	„ „	5·263	3·0750	3·0808	1·173
„ „	„ „	5·701	3·3437	3·3453	1·176
„ 8 and 9.	110 „	6·492	...	3·7815	1·165*

* Deposit rough copper lost from both coils..

Fortenbaugh and West, also students in the laboratory, making use of a watch belonging to the former, known to the writer to have been keeping correct time, and otherwise precisely the same apparatus that Mr. Gunning used, obtained the following result:—

Duration ... ... 40 m.
Current ... ... 1·314
Coil No. 1 gained... ... ... 1·036 } Area.
„ 2 „ ... ... 1·035 } 90 sq. c.m.

From this the number of grammes per ampère per hour is computed to be 1·182. And we know that for the above current density it should be 1·183. The galvanometer at the observatory is subject to a fluctuation in its indications by an amount that almost covers the above, due to variations of horizontal intensity throughout the succession of day and night.

The writer and Mr. E. G. Merritt, Fellow in Physics, Cornell University, hope to make a thorough investigation of the "Spiral Coil Voltameter" in its use with silver and copper shortly.

From the ease with which those inexperienced in the use of the copper voltameter obtain consistent results, it was thought well to recommend its use in the meantime to others.

ON THE EFFECT OF TEMPERATURE ON THE SPECIFIC INDUCTIVE CAPACITY OF A DIELECTRIC.

By W. CASSIE, M.A. Communicated to the Royal Society by Prof. J. J. Thomson, F.R.S.

[ABSTRACT.]

THE variation with temperature of specific inductive capacity was measured in different ways for solids and liquids.

In the case of solids a condenser was made with thin sheets of the dielectric in question, and the capacity measured at different temperatures. The condenser was suspended in an air bath by wires passing through the top to an insulated support outside. This support was several feet above the bath, so that it was never heated, and its insulation was independent of the temperature of the condenser. The capacity was measured by Prof. J. J. Thomson's method,* and conduction or absorption in the condenser allowed for by varying the time of charge and discharge. The rate of increase per degree centigrade of the specific inductive capacity was found to be for—

Mica	between	11°	and	110°	... 0·0003
Ebonite	„	13	„	68	... 0·0004
Glass	„	17	„	60	... 0·0012
Another specimen of „	„	13	„	60	... 0·002

In the case of liquids a quadrant electrometer was immersed in the liquid in question, and the deflection observed at different temperatures. The liquid was heated in a water bath, and the needle and quadrants were attached to insulating supports above the bath. The electromotive force was obtained from a Ruhmkorff coil without the condenser, and with a high resistance between the terminals by which to control the E.M.F. The poles of a second electrometer in air were connected to the poles of the liquid electrometer, and the ratio of the readings of these two gave a measure of the specific inductive capacity independent of variations of E.M.F. The results are shown in the following table; and in the last column are inserted for comparison the rate of change of refractive index for the four of the liquids for which Messrs. Dale and Gladstone have determined it. Mean values are given except for these four. For glycerine there is no similarity between the two effects; but for the other three the effects are of the same order of magnitude, although not exactly in the ratio 1 : 2 indicated by the electro-magnetic theory of light.

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* Brit. Asso. Meeting, 1886. *N. Y. Elect'n.*, 1887.

* "Phil. Trans.," 1883.

	Rate of decrease of specific inductive capacity per degree.		Rate of decrease of refractive index per degree for A line in solar spectrum.	
Turpentine	between 20° and 36°	0·0012	between 10° and 47°	0·00035
„	„ 49	0·0011		
„	„ 62	0·0009		
Carbon bisulphide.	15° and 43	0·004		
Glycerine	18 and 41	0·006	20° and 46°	0·00018
„	„ 61	0·0053		
Benzoline	19 and 41	0·0006	25° and 39°	0·00037
„	„ 52	0·0011		
„	„ 63	0·0015		
Benzine	15 and 39	0·0014	10° and 39°	0·0004
„	„ 58·5	0·0012		
Olive Oil	17 and 68	0·0024		
Paraffin Oil	18 and 54	increase 0·0023		

SPECIFIC INDUCTIVE CAPACITY OF DIELECTRICS WHEN ACTED ON BY VERY RAPIDLY ALTERNATING ELECTRIC FORCES.

By J. J. THOMSON, M.A., F.R.S., Cavendish Professor of Physics, Cambridge. Communicated to the Royal Society.

THE researches of Dr. John Hopkinson have shown that in some dielectrics, of which the most conspicuous example is glass, the refractive index is not, as it ought to be on Maxwell's theory, equal to the square root of the specific inductive capacity, when the latter is measured for steady forces, or such as are reversed only a few thousand times a second. It is therefore desirable to measure the inductive capacity under circumstances which approach as nearly as possible to those which, according to Maxwell's theory, occur when light passes through a dielectric. This will be when the forces are reversed as rapidly as possible; in the following experiments the forces were reversed about 25,000,000 times per second.

The method consists in measuring the wave length of the electrical vibrations given out by a condenser whose plates are in electrical connection. If C is the capacity in electrostatic measure of the condenser, L the coefficient of self-induction in electromagnetic measure of the circuit connecting the plates of the condenser, the wave length, if it is long compared with the length of this circuit, equals $2\pi\sqrt{(LC)}$. Thus, if we can measure the wave length of the vibrations executed by such a system, we can find the specific inductive capacity of a dielectric. For, if we determine the wave length of the system first when the plates of the condenser are separated by air, and then when they are separated by a slab of the dielectric whose specific inductive capacity we wish to measure, the ratio of the squares of the wave lengths will be the ratio of the capacities of the condenser in the two cases, and if we know this ratio we can deduce the specific inductive capacity of the dielectric interposed between the plates.

The arrangement of the experiment was as follows:—

The condenser consisted of two circular zinc plates, A B, C D, 30 cm. in diameter; these were supported on an insulating stand, and the distance between them could be altered at pleasure. To these plates wires, E F, G H, each about 25 cm. in length, terminating in the highly polished balls, F, H, were attached. The plates were also connected with the poles, P, Q, of an induction coil, and when this was in action a succession of sparks passed between the balls, F and H. The periodic distributions of electricity thus produced over the plates sent electrical waves down two insulated wires, each about 20 metres in length, attached to the small zinc plates, L and M, placed close to the plates of the condenser.

The wave length of the vibrations transmitted along the wire was determined by the method I described in a former paper ("Note on the Effect Produced by Conductors in the Neighbourhood of a Wire on the Rate of Propagation of Electrical Disturbances along it," *Roy. Soc. Proc.*, Vol. 46, p. 1). Two wires, R S, V W, of equal length, had the ends, S and W, fastened to the poles of a spark micrometer, while the other ends, R, V, could slide along the wires, L T, M A, respectively. At first, R was placed at T, and V was moved until the sparks in the micrometer were as small as possible; suppose that α was the position of V when this was the case. T and α will be at the same potential. The end, V, was now kept fixed at α, and R moved until the sparks again became as faint as possible; suppose that β was the position of R when this was the case, then β and α are at the same potential, and therefore β and T are; so that, since T is a place of maximum potential, β T equals a wave length.

By starting from β and proceeding further up the wire we can get another determination of the wave length.

Since from the nature other conductors besides the two discs were in the field, the capacity of the condenser was in excess of the value given by the formula $s/4\pi t$, where s is the area of one of the plates and t the distance between them; but this is the only part of the capacity which is increased when the slab of dielectric is interposed between the plates. The capacity when the discs were 2 cm. apart was determined by the tuning fork method given in Maxwell's "Electricity and Magnetism," vol. 2, and was found to be 40 in electrostatic units; the formula $s/4\pi t$ would, where $s = \pi \times 15^2 + t = 2$, give 28, so that of the 40 units of capacity, 28 are due to the two discs and 12 to the presence of the other conductors. This was verified by determining by the tuning method the capacity of the condenser when the distance between the discs had a series of values.

When the distance between the discs was 2 cm., the mean of several determinations of the wave length along the wire was 8·25 metres. The value calculated by the formula $2\pi\sqrt{(LC)}$, where

$$C = 40 \text{ and } L = 2l\left(\log\frac{8l}{\pi d} - 1\cdot75\right),$$ where l = length of circuit = 50 cm., and d the diameter of the circuit = 0·3 cm., is 8 metres. When the plates were separated by pieces of plate glass 2 cm. thick, the wave length was 11·75 metres. Thus, if K is the specific inductive capacity of the glass,

$$\frac{11\cdot75}{8\cdot25} = \sqrt{\frac{28K + 12}{40}},$$

$$K = 2\cdot7, \qquad \text{and } \sqrt{K} = 1\cdot65.$$

The determination of the specific inductive capacity of the glass by the tuning-fork method was difficult, owing to electric absorption; the values for K obtained in this way varied between 9 and 11. We see, therefore, that for vibrations whose frequency is $3 \times 10^{10}/11\cdot75 \times 10^2$, or 25,000,000 per second, the specific inductive capacity is very nearly equal to the square of the refractive index, and is very much less than the value for slow rates of reversals. The discrepancy is probably due to something which produces the phenomenon of anomalous dispersion in some substances, and indicates the existence of molecular vibrations having a period slower than 25,000,000 per second. The behaviour of the glass under electrical oscillations of the critical period would form a very interesting subject of investigation.

The specific inductive capacity of ebonite was determined in a similar way; the wave lengths, when the plates were separated by air and ebonite respectively, were 8·5 metres and 10·75 metres, giving as the specific inductive capacity of ebonite 1·9. The value determined by the tuning-fork method was 2·1.

The specific inductive capacity of a plate made of melted stick sulphur was also tried: the wave length without the sulphur was 8·25, with it 11·5, giving as the specific inductive capacity of sulphur 2·4. The value determined by the tuning-fork method was 2·27. Thus, for ebonite and sulphur the values determined by the two methods agree as well as could be expected, while for glass the results are altogether different.

AMERICAN NOTES.

By DAS TELEPHON.

NOTHING worthy of being recorded in the REVIEW has come out lately. The first execution by electricity (I *mean lawful* execution), is looked forward to with anxiety by the public as well as by the electrical brotherhood.

In his long story of the electric sugar swindle, President W. H. Cotterill reached the climax yesterday in his testimony before Recorder Smyth, when he told of his trip to Michigan last December. Mrs. Friend had postponed giving up the secret so often that the English stockholders became indignant and suspicious. When he asked Mrs. Friend whether she really possessed a secret for refining raw sugar, she replied that "it was an improper question for him to ask."

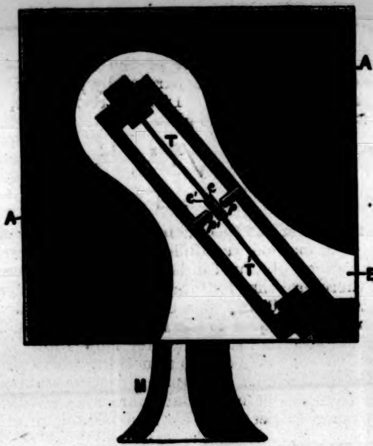
Cotterill described his entrance into the Professor's secret room, and told how he found the raw sugar, which they supposed had been refined, piled up behind a barricade of empty boxes which had purported to contain machinery, but which had really been used to bring refined sugar into the factory.

Several letters were found by Cotterill from Howard to Gus Halstead, which he opened. One of the letters was very urgent, and told Halstead to gather everything together, put it in the secret room, and send him the key at once. He asked that this be done in three hours. Close on the heels of this came another letter, telling him to send the key five minutes after he got the letter, adding the memorable words, "Burn this letter." By these means Howard hoped to have everything beyond the reach of Cotterill when he came back from Michigan.

The famous Bell patent is again before the Courts. On the 1st inst. the United States Circuit Court at Boston was called to consider another point in the bill in equity to cancel the Bell telephone patent on the ground of prior invention by Reis, of Germany, by Gray, by Drawbaugh and others; also on the ground of fraud by Bell in the Patent Office. The Bell Company originally demurred on the ground of no authority by the United States to bring suit. The Supreme Court overruled this demurrer, and ordered the company to answer. They answered and filed a plea. The United States filed replication. Now the United States asks that an examiner be appointed to take the proofs, and the Bell Company asks the Court to restrict proofs to the fraud issue on the ground that many of the other grounds for the repeal of the patent set up in the bill are before the Circuit Court in other cases.

In the REVIEW I have heretofore expressed my opinion that the only question which the Court could entertain was as to the fraud, but from decisions lately given by the U.S. Supreme Court, I am now inclined to believe that the Court has the power to investigate all charges which, if true, would invalidate a patent.

I send you a clipping from the leading daily paper in Baltimore, parts of which may be interesting to your readers outside of the U.S. Patentees of microphones here are equally excited over the broad claim of Berliner for the great principle of the microphone.



THE BARNEY TELEPHONE.

A, A, wooden core; M, mouthpiece; T, tympan; P, P', electrodes fixed to frame; C, C', electrode in tympan; air waves pass through M, strike T, pass around frame condensed on other side of T, and pass out at E.

[EXTRACT.]

"FUTURE OF THE TELEPHONE.

"No danger that the Bell Monopoly will be broken up.

"It is generally believed by the public and by many inventors of telephonic apparatus that, after the expiration, in 1893, of the famous Bell patent of March 7th, 1876, the lawful monopoly now held by the American Bell Telephone Company will expire by limitation.

"The hopes and expectations of the long suffering public are doomed to disappointment. The present monopoly of telephony, held by the American Bell Telephone Company under the Bell patent, will cease when that patent expires, but that company long since acquired inventions which will control absolutely the use of all forms of microphones, which is the only and essential instrument now known by the public for the transmission of speech by means of electricity under the Bell system, which the Supreme Court said 'consisted in the use of an undulatory current in a closed circuit,' and to the use of that instrument the world is indebted for the practical use of the electric telephone.

"The Supreme Court of the United States, in the opinion delivered on 19th March, 1888, said:—

"'Bell discovered that speech could be transmitted by gradually changing the intensity of a continuous electrical current in a closed circuit; but, if another discovers a different method or way of doing the same thing, and gets a patent for it, the two discoverers will be permitted to operate each in his own way without interference with each other.'

"It is sincerely to be hoped that the inventive genius of some of our electricians will soon discover that 'different method,' and relieve the public from the exactions of the great monopoly.

"The microphone is the only instrument now known which will transmit speech in a practical way, and the owners of that instrument will continue to control the practical use of the telephone in the United States. Thousands of microphones, of various forms and shapes, have been invented, but they all will be subservient to the patent, which will hereafter be issued to the American Bell Telephone Company for the microphone.

"The microphone was claimed in a *caveat*, filed in the Patent Office on April 14th, 1887, by Emile Berliner. The claim is in these words:—

"'In an instrument situated within an electric circuit, having two or more ends of the circuit brought in contact with each other, which points of contact can be loosened or tightened by vibrating one or both sides of each contact, thus diminishing or increasing the current of electricity passing through the contacts as many times as vibrations occur.'

"This claim describes the microphone, and is so broad and so clear that it covers all forms of microphones now known or which may be invented, and, without the microphone, the present Bell telephone system is not a commercial or practical one.

"Patentees of microphones now, for the first time, learn that their patents are worthless, and that the American Bell Telephone Company own this invention, and that company also owns the invention of Thomas A. Edison of a similar instrument, for which he filed an application for a patent on July 20th, 1887. No patent for the microphone has been issued to Berliner or Edison under their application, for the reason that those two claimants were put in interference by the Patent Office, and the important point is that the interference has been kept alive, and has not been decided by the Patent Office.

"The American Bell Telephone Company own both these inventions, and the decision of the Patent Office can be deferred from year to year by that company, as long as it may deem best for its interests, and that company, no doubt, will defer asking a decision from the Patent Office until a short time before the Bell patent of March 7th, 1876, expires, and then a patent for the microphone will be issued, either for the Berliner or Edison instrument, to the American Bell Telephone Company, which will run for 17 years from the date of issue of the patent, thereby securing to that company a continuance of its monopoly until 1910, unless, as the Supreme Court said, 'another discovers a different method from that of Bell.'

"It is hoped men of science and intelligent mechanics will endeavour to discover that 'different method.'"

The Barney make-and-break telephone has been under crucial tests by several eminent electrical experts in New York, all of them believers of the Bell theory, and the report given is in the following words:—"The diaphragm plays between two distinct limiting contacts, each of which is proven to be necessary by the fact that if either is slightly out of a given position (either way) the apparatus will not talk at all."

The expert who made this written report would not admit that the instrument talked by make-and-break.

Another expert wrote:—1. The diaphragm is not in contact with the two distinct points at the same time, because if it were so the diaphragm could not *play* between them.

2. As the two distinct limiting contacts are proven to be necessary for the apparatus to talk, it follows that the diaphragm must *make* and *break* contact alternately in each of the distinct limiting points.

3. The result of the tests establishes the fact that the apparatus will not talk except when makes-and-breaks of contact occur.

This is a hard *fact* for *blind* followers of the Bell system; but it is a fact, and cannot be denied on the ground that it was not known before. Let the sceptical examine the drawing of the instrument, and he will see that double the number of pulsations are sent into the line that were or could be read, by any known method.

Baltimore, *June 14th*, 1889.

NEW PATENTS—1889.

8360. "Improvements in apparatus relating to telephone systems." F. A. HOLCOMB. Dated May 20. (*Complete.*)

8390. "Improvements in electric motors." W. M. MORDEY. Dated May 21.

8400. "An improvement in electric bells." J. M. PORTER. Dated May 21.

8451. "Improvements in conduits for electric light and other wires." G. GOLLOP. Dated May 21.

8456. "Improvements in portable electric safety lamps." L. BRISTOL. Dated May 21. (*Complete.*)

8459. "Improvements in dynamo-electric machines and electric motors." T. L. WILLSON. Dated May 21.

8460. "Improvements in coating and protecting wires for electrical, telephonic, and other analogous purposes, also applicable in the manufacture of tubing." G. FRANCE and E. HOLROYD. Dated May 21.

8468. "Improvements in tramcars, locomotives, or other vehicles driven by electricity." T. D. HOLLICK. Dated May 21.

8493. "Improvements in automatic cut-outs for electric circuits." W. J. S. BARBER-STARKEY. Dated May 22.

8528. "Transmission of power by alternate electric currents and apparatus therefor." J. HOPKINSON. Dated May 22.

8552. "An improved process for the electrolytic separation of aluminium, aluminium alloys, and magnesium from solutions of their salts." G. NAHNSEN. Dated May 23.

8557. "Improvements in or relating to meters or instruments for measuring currents of electricity." M. PARKER. Dated May 23.

8559. "Improvements in securing telegraph wires to insulators." W. OSBORNE and J. S. SCALES. Dated May 23.

8569. "Insulating and suspending wires, cables and conductors for electrical currents." W. J. L. SANDY. Dated May 23.

8588. "Improvements in alternating current dynamos and motors." J. Swinburne. Dated May 23.

8606. "An improved form of secondary battery for the use of miners and the like, and lamp mount for same." M. Bailey and J. Warner. Dated May 23.

8619. "An improved electrical alarm for audibly indicating and announcing the varying water levels of steam boilers and the like." A. Siegmann. Dated May 23. (*Complete.*)

8631. "An improved portable electric lamp and battery." R. Thompson and H. S. Pyne. Dated May 24.

8657. "Improved methods and appliances for conducting and distributing electric currents." E. B. Bright, F. W. Engelbach and J. B. Bright. Dated May 24.

8674. "Improvements in connection with electrical tramways or railways." J. Hopkinson. Dated May 24.

8692. "Improvements in multiple switch-board systems for telephonic exchanges, and wire bands to be used therein." J. E. Kingsbury. (Communicated by the Western Electric Company, United States.) Dated May 24.

8709. "Amalgamating gold by electricity and mechanical motion." E. H. M. Andreoli. Dated May 27.

8730. "Improvements in printing telegraphs." A. M. Clark. (Communicated by W. F. Johnson, United States). Dated May 27. (*Complete.*)

8769. "Improvements in electrical measuring instruments." A. C. Cockburn and J. N. Cooper.) Dated May 27.

8776. "A combined postal, electric signal alarm and telephone pillar." E. Hasselbach, M. H. Hyman and J. A. Alexander. Dated May 27.

8780. "Improvements in electrical switches." E. E. de Facien. Dated May 27.

8793. "Improvements relating to screw-cutting lathes, and to electrical indicating apparatus for use in connection therewith." W. H. Winnall. Dated May 27.

8800. "Improvements in regulators chiefly designed for use in electric arc lamps." H. H. Lake. (Communicated by O. H. L. Lindemann, Germany.) Dated May 27.

8815. "Improvements in devices for automatically interrupting an electric circuit under predetermined conditions." W. P. Thompson. (Communicated by the Westinghouse Electric Co., United States.) Dated May 28.

8861. "Improvements in electric switches." O. Imray. (Communicated by W. Thompson, United States.) Dated May 28. (*Complete.*)

8905. "Receiving and transmitting an electric current for telephonic, telegraphic or other electrical purposes, viz., 'the anti-alternate current relay.'" A. G. Burrell. Dated May 29.

8925. "Improvements in electric batteries." C. Wells. Dated May 29.

8958. "An electric meter." A. Frager. Dated May 29.

8973. "Improvements in the method of and means for collecting and storing electrical energy." F. Bosshardt. (Communicated by V. Hoeft & Co.. and R. F. Verdier, Belgium.) Dated May 30.

8979. "Improvements in electric switches." F. V. Andersen. Dated May 30. (*Complete.*)

8986. "Improvements in secondary batteries." D. Urquhart, W. Bates, and F. Wynne. Dated May 30.

8999. "Improvements in electrical tramways, or railways, and apparatus therefor," J. Hopkinson. Dated May 30.

9026. "A new and improved means of and apparatus for inducing incandescence for illuminating and other purposes." J. G. Irwin and A. Isaacs. Dated May 31.

9034. "Improvements in self-contained dome electric bells." W. Pressland and W. T. Pressland. Dated May 31.

9066. "Improvement in railway fog signals, viz., 'the electric fog signal.'" E. A. Harvey and M. E. Brooke. Dated May 31.

9093. "Improvements in storage batteries. A. Jung. Dated June 1.

9096. "Improvements in telephonic switch boards." H. F. Jackson, and D. Sinclair. Dated June 1.

9119. "Improvements in electric bells." E. T. Fiford. Dated June 1.

9133. "Improvements in the manufacture of carbons or electrodes for electric lamps." H. H. Lake. (Communicated by Messrs. Lacombe & Co., France.) Dated June 1.

9163. "Improvements in electricity meters, or apparatus for measuring electricity, partly applicable for other purposes." L. B. Miller. Dated June 3.

9166. "An improved electrical repeater and commutator to indicate the normal position, and the movements of railway or other signals, slots, and the like." D. Wells. Dated June 3.

9182. "Improvements in apparatus or devices for switching or diverting electric currents, more especially intended for use with telephonic circuits." A. Graham. Dated June 3.

9183. "An improved exciting liquid for electric batteries." M. Sussmann. Dated June 3.

9185. "Electric safety signalling devices for raiiways." J. Haas. Dated June 3.

9197. "Improvements in and relating to relays for telegraphic purposes." H. Lubliner. Dated June 3.

9231. "Improvements in the method of and devices for regulating currents generated by shunt wound dynamo-electric machines." W. E. Heys. (Communicated by E. P. Clark, United States.) Dated June 4. (*Complete.*)

9237. "Improvements in dynamo electric generators and motors." G. E. Dorman. Dated June 4.

9241. "Electric meters." A. A. C. Swinton. Dated June 4.

9258. "Improvements in electric signal lamps and appliances connected therewith." F. L. Rawson and W. S. Rawson. Dated June 4.

9284. "Improvements in metallic telephone circuits." H. L. Burbank. Dated June 4.

9294. "Improvements in and relating to dynamo-electric machines and electric motors." H. H. Lake. (Communicated by C. S. Bradley, United States.) Dated June 4.

9300. "Improvements in and relating to dynamo-electric machines." H. H. Lake. (Communicated by H. Lemp, United States.) Dated June 4. (*Complete.*)

9304. "Improvements in switches for electrical purposes." W. Barnicoat. Dated June 4.

9350. "Improvements in dynamo-electric machinery." J. Johnson and F. Russell. Dated June 5.

9352. "Improvements in electrical horology." F. Espir. (Communicated by L. Belzon fils, France.) Dated June 5.

9376. "Improvements in miners' electric lamps." H. I. Harris. Dated June 5. (*Complete.*)

9397. "Improvements in electrical thief detectors." H. W. C. Cox. Dated June 6.

9440. "Improvements in ceiling roses for suspending electric lamps and other electrical purposes." E. W. J. Macdonald. Dated June 7. (*Complete.*)

9445. "Lightning arresters for electric conductors." J. W. See. Dated June 7.

9456. "Improved method for preventing fumes from secondary batteries." B. M. Drake and J. M. Gorham. Dated June 7.

9461. "Improved composite electric omnibus." D. M. Reid. Dated June 7.

9509. "Improvements connected with electrically operated coal mining and drilling machines." E. A. Sperry. Dated June 8. (*Complete.*)

9528. "An improvement in telephony." H. Coles. Dated June 8.

9537. "Improvements in incandescent electric lamps." I. A. Timmis. Dated June 8.

9541. "Improvements in appliances for attaching telegraph and other wires to insulators and similar uses." F. Lindley. Dated June 8.

9552. "Improvements in electric meters." W. J. S. Barber-Starkey. Dated June 8.

9571. "Arrangement of circuits and apparatus to be used in connection with telephonic communication." J. E. Kingsbury. (Communicated by F. R. Welles, Belgium.) Dated June 8.

9576. "Improvements in and relating to incandescent electric lamps." H. H. Lake. (Communicated by S. F. Van Choate, United States.) Dated June 8. (*Complete.*)

9589. "Improvements in electric signals for indicating the direction and speed of revolution of engine shafts." J. C. Ricketson. Dated June 11. (*Complete.*)

9667. "Improvements in apparatus for the generation of electricity." G. Wilkinson. Dated June 12.

9681. "Improvements in electrical storage or secondary batteries." R. Tatham. Dated June 12.

9713. "Improvements in electric conductors." J. G. Lorrain. (Communicated by La Société d'Exploitation des Cables Electriques Système Berthoud, Borel et Cie., Switzerland.) Dated June 12.

9723. "Improvements in grids or containers for the elements or plates of secondary batteries and moulds to be used in their manufacture." The Electrical Power Storage Company and P. J. Rea. Dated June 12.

9743. "Improvements in field magnets of dynamo and electromotors." C. Richardson. Dated June 13.

9745. "Improvements in or relating to dynamo-electric machines." W. S. Boult. June 13.

9791. "A thermo-dynamic motor, especially adapted for impelling, ejecting, or propelling high explosive projectiles and the like." B. H. Thwaite. Dated June 14.

9828. "Improvements in secondary voltaic batteries." W. J. S. Barber-Starkey. Dated June 15.

ABSTRACTS
OF PUBLISHED SPECIFICATIONS, 1888.

3679. "An improved apparatus for regulating electric currents, applicable also as a motive power appliance." H. H. Lake. (Communicated from abroad by Prof. Elihu Thomson, of America). Dated March 1. 8d. Consists in the combination with a core or carrier of iron, of ring or other endless form, of two coils or conductors applied thereto but adjustible or movable in position or inductive relation with respect to one another, one of said coils or conductors being in the alternating current circuit, while the other is preferably in an independent closed circuit, closed on itself and is the seat of induced currents produced by the alternating currents flowing in the other conductor. The claims are 8 in number.

4336. "Improvements in electrical switches." T. SPENCER. (A communication from H. T. Paiste, of America) Dated March 12. 6d. The object of this invention is to construct an electric switch by which the circuit can be instantly made or instantly broken, to prevent what is termed sparking, and, furthermore, to so construct the switch that it will be impossible for the operator to control the making or breaking circuit of the arm after it reaches a certain point in its revolution. The claims are 4 in number.

5098. "Method of and apparatus for electrical signalling or announcing in connection with telephone circuits." P. L. KRICBOOM. Dated April 5. 8d. Relates to a new method of and apparatus for electrical signalling or announcing whereby any person in possession of a private telephonic line connecting two buildings or establishments can be instantly informed of any attempt at burglary or of any commencement of fire that may be taking place at either building. It also enables a person whose dwelling is connected with a central telephonic station to avail himself of an automatically operating apparatus for informing such central station of any attempt at burglary or commencement of a fire that may take place at the dwelling. The claims are 2 in number.

5162. "Improvements in electric generators." W. M. MORDEY. Dated April 7. 8d. Has for its object to provide a single armature coil or winding, in place of a considerable number of such coils or windings. Thus the inventor constructs alternate current machines for any required rate of alternations, in which there is but one simple armature coil and one simple field magnet coil. The claims are 7 in number.

5531. "A new or improved system of electric lighting and apparatus therefor." J. G. STATTER. April 13. 8d. The inventor employs alternating currents of electricity generated by an alternating constant current dynamo, which currents are transmitted through transformers arranged in series, and the secondary circuits of which transformers each contain one or a few incandescent lamps. The current from the dynamo is maintained constant by employing an automatic electric regulator to alter the position of the brushes on the commutator of the exciter, the said regulator being fed and actuated by the current from the alternating current machine, and not by that from the exciter. The claims are 4 in number.

6909. "Apparatus for operating and locking the brushes of dynamo-electric machines." E. J. HOUGHTON. Dated May 9. 8d. When working dynamo machines it is in some cases desirable for their brushes to be brought into operation by means of electromagnets and locked when either on or off as the case may be. In the electric lighting of railway trains for example where separate sets of brushes are used for "up" and "down" running it is necessary that one set should be locked or prevented touching the commutator when the other set is at work. The inventor does this by attaching the armature of an electromagnet to each set of brushes in such a manner that when either electromagnet is brought into operation that set of brushes to which its armature is attached is brought to bear on the dynamo commutator. At the same time the other electromagnet is locked so that the brushes to which it is fixed are prevented from touching the commutator. When neither set of brushes is required to be used both electro magnets are locked. A current passing through the electromagnets unlocks their armatures, when they are unexcited the armatures are locked. The claims are 2 in number.

6961. "Improvements in automatic electric batteries." G. A. NUSSBAUM. Dated May 10. 8d. The object of the invention is to construct a simple, cheap and reliable battery for the purpose of obtaining electric shocks without the aid of an attendant, and in exchange of a coin or the like to be inserted in a slot provided in the box containing the apparatus. The claims are 4 in number.

7083. "Improvements in electro medical batteries." T. W. FORD. Dated May 12. 8d. Consists of a box or case containing mechanism and cells necessary to work the same, of ornamental design and of suitable dimensions for attaching to a counter or pedestal or for fastening to a wall, &c. A slot is provided in the front of the machine for the reception of money, having below it an ordinary lock, the bolt of which when shot up prevents the insertion of a coin, thus shutting up the slot when the machine is out of order. Electric action is set up by a penny falling down the shoot on to a short lever. The claims are 4 in number.

7655. "Improvements in electric conductors and in conduits therefor, and laying and supporting conductors within conduits." R. E. B. CROMPTON. Dated May 25. 1s. 1d. Consists of bare copper strips, supported on insulators of peculiar form, and arranged in underground culverts. The claims are 15 in number.

8099. "Improvements connected with electrical hoists or cranes." R. E. B. CROMPTON, J. F. ALBRIGHT, and J. H. F. SOLL. Dated June 4. 8d. The inventors arrange that the motor runs continuously in one direction. It can therefore be shunt wound, and consequently can be easily arranged to hoist at a continuous speed even with a widely varying load. In one form of the invention they use a motor with a friction pulley and the fly-wheel mounted on its spindle. In order to actuate the first wheel of the train of gearing the motor itself is moved through a small distance so as to bring the friction pulley into more or less close contact with the smooth surface of this first wheel. The claims are 3 in number.

CORRESPONDENCE.

Electric Lighting of Trains.

In your issue of the 14th inst. I observe that you bring very prominently under notice the doings of the Midland Railway Company in the matter of electric lighting of trains.

Perhaps you will be kind enough to notice in your next issue that the L. & N.W. Company have, since August, 1884, been running very successfully an electrically lighted train between Manchester and Liverpool.

The arrangement comprises :—Two 16 C.P. lamps in each compartment; one Siemens's compound shunt dynamo, driven by a "Brotherhood" engine, both fixed on the tender of the locomotive; one ammeter and switch (with tell-tale lamp) on the engine, to enable the driver to regulate the current; and a special appliance in each compartment, so that if a lamp goes out from any cause a second lamp is brought in automatically.

The current is supplied direct from the dynamo to the lamps.

In addition to this, we have also given some attention to the question of providing accumulators in the carriages, which may be charged from a stationary dynamo at the depôt or from the dynamo on the engine, as referred to above. A saloon has been so fitted since March, 1888 (Phœnix or E.P.S. accumulators being used), and has traversed almost the whole of the L. & N.W. system, giving great satisfaction.

Jno. Wm. Fletcher,
Assoc. M. Inst. C.E. and M.I.E.E.

London and North-Western Railway Telegraph
Department, Chief Superintendent's office,
Manchester, *June 24th*, 1889.

Elmore Copper Depositing Process.

With reference to your article on the Elmore Copper Depositing Process, in your issue of the 14th, we regret that two mistakes should have crept in. One of them has been pointed out by your correspondent, who justly remarks that the current density should be 15 ampères per square foot cathode, not square inch, and the other is in the actual current employed, which should be 56·7 ampères, and not 36·7, as printed.

Trusting that you will kindly notice this errata,

W. Stepney Rawson.

June 24th, 1889.

Electric Lighting in Nottingham.

We observe in your leading article of the 21st inst. a statement to the effect that the town of Nottingham does not at the moment possess a single electric light installation. On this question you appear to have been misinformed, as Messrs. Thomas Adams and Company, Limited, have had an installation, fitted by us in 1885, in constant use since that date. In answer to our enquiries made upon seeing your article, Messrs. Adams write, under date of the 25th, to say that not only is their own installation regularly at work, but they believe their neighbours, Messrs. Birkin Bros., continue to run theirs, and that Messrs. Copestake, Lindsay & Co., have an installation regularly in work.

Paterson and Cooper.

June 26th, 1889.